U.S. Department
of Transportation
Federal Aviation
Administration

U.S. Department of Transportation

Federal Aviation Administration

Specification

ELECTRONIC EQUIPMENT, GENERAL REQUIREMENTS

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1 SCOPE AND PURPOSE

1.1 Scope.

This specification is the technical baseline for ground based electronic equipment acquired for applications in the National Airspace System (NAS). This specification defines the conditions under which electronic equipment must operate satisfactorily and reliably: identifies acceptable fabrication materials and processes, selection and application of parts, installation of equipment, and tests to verify electronic equipment meets requirements. Individual electronic equipment specifications must identify applicable requirements of this specification. This specification is intended for use in the procurement of all electronics hardware, prototype systems, developmental equipment or commercial off the shelf integrated systems, delivered in any quantity to satisfy an established air traffic need or proof of concept configuration.

1.1.1 Intended Use.

This specification is to be used in conjunction with the equipment specification to establish the procurement requirements. This specification should not be invoked on a blanket basis in equipment specifications.

1.1.2 Tailoring of this Specification.

The requirements set contained in Section 3 of this general specification may, at the discretion of the responsible organization designated by the FAA Acquisition Management System (AMS), be tailored to the specific needs of an individual system or subsystem. The process for and the documentation of such tailoring is defined below.

1.1.2.1 Process

The responsible organization under AMS (e.g., the Investment Analysis Team during Investment Analysis, or the IPT/PT during Solution Implementation) may authorize the tailoring of Section 3 requirements. The specifics of the tailoring shall be evaluated in the context of the system technical requirements, risk, and affordability, then documented as defined in section 1.1.2.2. The fact of the tailoring, including a specific reference to its documentation, shall be communicated to the appropriate AMS-designated decision makers in a timely manner. This communication shall take place as early in the current lifecycle phase as is practical and, under any circumstance, shall be accomplished in time to support the AMS en-of-phase decision point (e.g., Mission Need Decision, Investment Decision, or In-Service Decision).

1.1.2.1 Documentation

After the responsible organization has determined the need for and has approved the tailoring of Section 3 requirements, the specifics of the tailoring shall be captured in the project baseline, as defined in the FAA Acquisition Management System (AMS). As a minimum, the following tailoring-related information shall be consolidated in an applicable, AMS-defined, baseline document, e.g., System Requirements Specification:

- Identification of each specific Section 3 requirement, by secton number, That is to be deleted or modified;
- The rationale for deletion or modification;
- The technical rist associated with the deletion or modification; and
- In the case of a modified requirement, a citation of the new requirement.

1.1.3 Classification.

Electronic equipment acquisition alternatives which are available include NDI, COTS, and developmental items. The selection of the appropriate acquisition alternative is the responsibility of the government program office, and should be dependent upon the expectations for the electronic equipment, availability of NDI or COTS equipment, and cost-benefit trade-offs. Specific acquisition requirements are the responsibiltiy of the acquiring office, and will be tailored within the range of acceptable limits provided herein.

2 APPLICABLE DOCUMENTS

2.1 Government documents.

The listing of government documents referenced in this document is contained in Appendix II.

2.2 Non-Government documents.

The listing of non-government documents referenced in this document is contained in Appendix III.

3 REQUIREMENTS

3.1 General.

The requirements for ground based electronic equipment stated in section are generally applicable to developmental, NDI and COTS equipment. A requirement which applies to either developmental or NDI equipment, or both, is identified by a note following the requirement stating: *(The Program Office should determine if this requirement is applicable to their project)*. Where English units of measurements are cited, the use of metric units is not prohibited.

3.1.1 Definitions.

3.1.1.1 Commercial-off-the-Shelf (COTS).

Commercial-Off –The-Shelf is defined as any item other than real property, that is of a type customarily used by the general public for non-governmental purposes, and that has been sold, leased, or licensed to the general public; is sold, leased, or licensed in substantial quantities in the commercial market place; and is offered to the Government without modification, in the same form in which it is sold, leased, or licensed in the commercial marketplace. Within this document, COTS is a subset of Nondevelopmental Item (NDI).

3.1.1.2 Developmental Item.

An item of supply, not previously available, developed uniquely to meet the requirements (performance and otherwise) of a specific procurement contract and/or equipment specification.

3.1.1.3 Fail-safe.

A failure does not adversely affect the safety of the NAS. This means that a failure in the equipment itself or in the equipment's monitoring capability shall cause the system to shut down if this failure would result in a safety hazard to the NAS user. This also means that a failure in the equipment shall not create a safety hazard to the personnel who maintain the equipment.

3.1.1.4 Fail-soft.

A failure in the equipment reduces the operational capability of the equipment but does not degrade the safety of the NAS. For example, when the (Remote Monitoring Subsystem) RMS of an equipment fails, the operational capability to remotely monitor and control the equipment is lost, but the equipment continues to operate safely with the local monitoring system. When the primary transmitter of a category II or III (Instrument Landing System) ILS fails, the equipment continues to operate safely on the standby transmitter, but the operational category is reduced to category I.

3.1.1.5 Modified COTS/Commercial Type Product.

COTS equipment that has been modified to meet functional requirements. Also means a commercial product (a) modified to meet some Government-peculiar requirement or addition or (b) otherwise identified differently from its normal commercial counterparts. Within this document, modified COTS equipment is a subset of NDI.

3.1.1.6 NDI (Nondevelopmental Item).

NDI equipment can be COTS, modified COTS, or previously developed. NDI shall be defined as any one of the following:

a. Item of supply that is available in the commercial marketplace (COTS).

b. Previously developed item of supply that is in use by a department or agency of the United States, a state or local government, or a foreign Government.

c. Item described above that requires only minor modification to meet the procuring agency's requirements (includes Modified COTS). Minor modifications are defined as modifications that do not adversely affect safety, durability, reliability, performance, interchangeability of parts or assemblies, maintainability, weight (where weight is significant), or any other significant objective of the end item. (See FAA Order 1810.6)

d. Item currently being produced that does not meet the above requirements solely because it is not yet in use, or not available in the commercial marketplace.

3.1.2 Electrical Power .

3.1.2.1 Internal/Building Wiring.

a. The electronic equipment electrical power interface to the building is shown in Figure 1. Building electrical wiring runs from the electronic equipment enclosure/cabinet to the building power source. Internal electrical wiring runs within the electronic equipment enclosure/cabinet. Electrical wiring connecting the electronic equipment enclosure/cabinet to a receptacle is considered internal wiring and not part of the building.
b. All internal wiring to the equipment shall be in accordance with Section 3.3.1.3.8, Wiring.
c. The equipment shall interface to building wiring in accordance with, FAA-C-1217, NFPA 70 and FAA-STD-032 in that order of precedence.
d. Electrical enclosures, cabling and wiring shall be approved by a nationally recognized testing laboratory. The term nationally recognized testing laboratory (NRTL) means an organization which is recognized by OSHA in accordance with Appendix A of Standards - 29 CFR 1910.7.

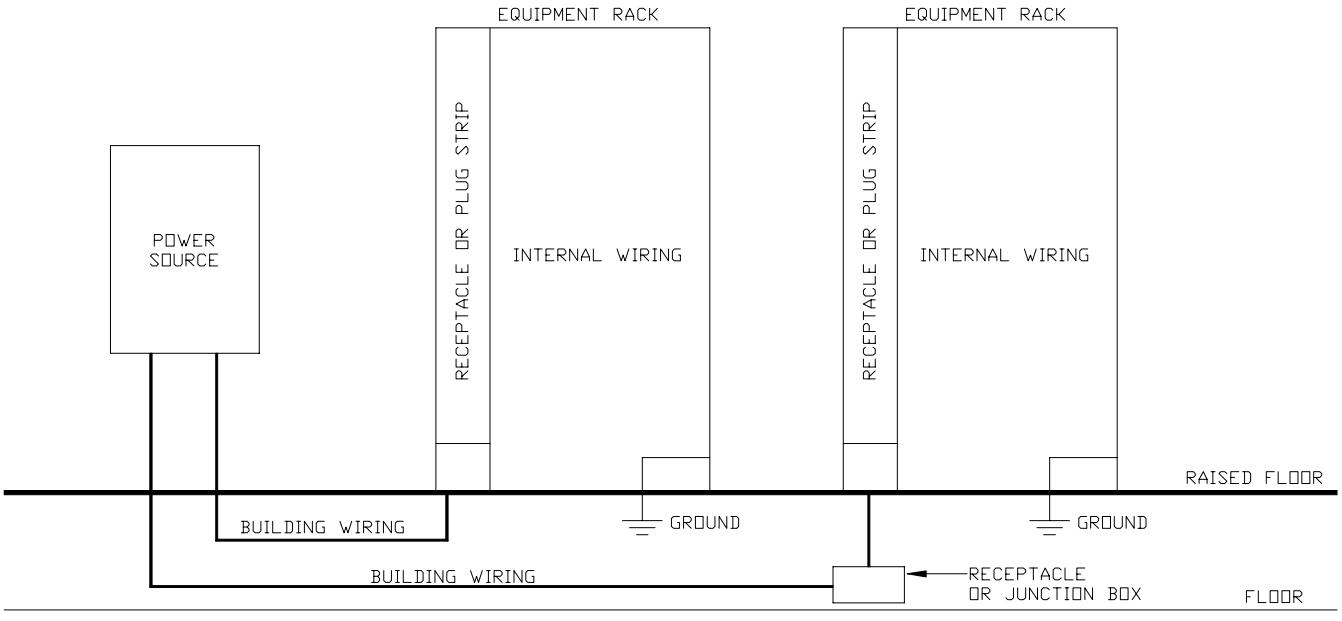


Figure 1. Internal/Building Electrical Power Wiring Diagram

3.1.2.1 Standards and Codes.

Equipment/systems shall be designed and constructed to meet applicable recognized industry standards.

3.1.2.2 Physical Requirements.

3.1.2.2.1 Physical Construction.

a. Accessibility
   1. Where special test equipment or maintenance equipment is necessary, accessibility for proper, safe use of this equipment in the equipment/system shall be provided based on NEC or OSHA.
   2. All access for electrical components, connections, wiring, etc., shall comply with 3.1.3.4.

b. Equipment Directly Connected to Line Power:
   1. Where units of equipment are directly connected to line power, controls and indicators for electrical line voltage shall be front panel mounted. When switches or circuit breakers function as main power disconnecting means, operating either directly or through a contactor, they shall break the incoming line immediately before the line filter, terminal block or connector, fuses or other parts without compromising REI, EMI shielding integrity.
   2. Equipment Connected By Cord and Plug to Line Power.Cord connected equipment/systems may be disconnected by means of the plug.

c. Alternating Current (AC) Line Connectors and Power Cord Plugs, receptacles, and power cords provided for connection of the equipment to the AC supply line shall meet the requirements of NEPA 70 and shall be recognized components bearing the listing mark of a Nationally Recognized Testing Laboratory (NRTL.
   1. The plugs and receptacles shall conform to W-C-596 and the power shall be a minimum 3-wire cord conforming to J-C-580.
   2. For 120 v maximum 15 amps, detachable power cords, the power cord shall be type SF, 3-conductor cord in accordance with J-C-580. The equipment end of the cord shall have a female plug per DESC 87204. The supply end of the cord shall have a male plug end of the cord per W-C-596/l3-3.
   3. Based on the criticality of the service, plugs and receptacles shall be of the locking type and conform to NEMA WD6-88.
   4. The power cord shall be rated for the environment.

d. Convenience Outlets: Convenience outlets provided on the equipment racks shall be duplex receptacles installed and wired in accordance with the NFPA 70. Cabinet wiring design shall provide for power to these convenience outlets from an AC line power source Independent of the equipment primary power source. Where sensitive test equipment, by necessity, must be connected to the same source the test equipment outlet must be clearly identified or protected from general use.

e. Segregate Power Source: If the equipment is sensitive to stray currents, the equipment shall be isolated from the rack.

3.1.2.3 Power Performance Requirements.

If the building power system requires modification to accommodate the electronic equipment, the modification of the building power system shall be in accordance with FAA-STD-032 and FAA Order 6950.2.

3.1.2.3.1 Load Power Characteristics.

3.1.2.3.1.1 Power Factor.

a. The power factor shall be within the ranges specified for the following ranges of power dissipation measured from the equipment end of the electrical power branch feed:

W (watts)	PF (power factor)
W < 2000	0.7(lag) – 0.7(lead)
2000 ≤ W ≤ 5000	0.8(lag) – 0.9(lead)
W > 5000	0.9(lag) – 1.0

b. Power factor shall be defined as the absolute value of the product of the displacement component of power factor and the distortion component of power factor.

$PF = |PF_{disp} \times PF_{dist}|$

c. The displacement component of the power factor, PFdisp, is equal to the cosine of the angle between voltage and current which can be calculated by dividing the power dissipation in watts by the apparent power in volt-amperes (VA).

$PF_{disp} = \text{Cos(theta)} = \text{Watts/VA}$

d. The distortion component of the power factor, PFdist, is equal to the reciprocal of the square root of one plus the square of the total harmonic distortion of the equipment (THD) as defined in IEEE STD 519-1992.

$$PF_{dist} = \frac{1}{\sqrt{1+(THD)^2}}$$

3.1.2.3.1.2 Inrush Current.

a. The limits for inrush current shall be imposed at the point of connection to facility power.
b. The limits (over-current and duration) shall be as shown in Figure 2., for loads greater than 600 watts.
c. The limits for loads with power requirements of 600 watts or less shall not exceed 1.5 times the overcurrent values shown in Figure 2.

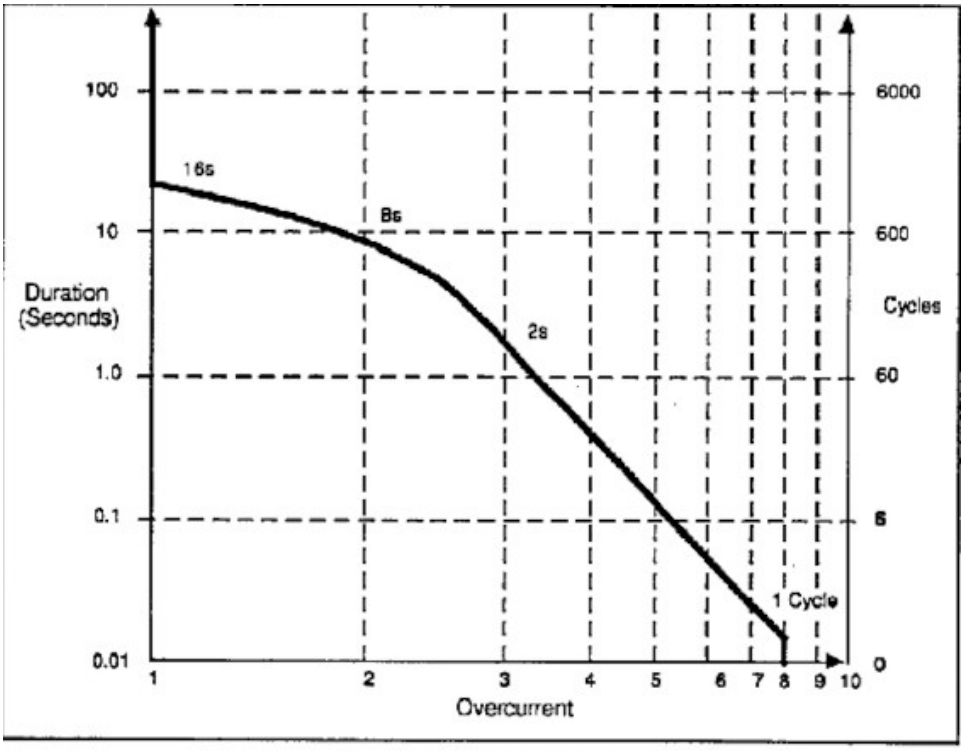


FIGURE 1. INRUSH CURRENT LIMIT RATIO

NOTE: Overcurrent is defined as the maximum peak current/current (RMS) steady state.

3.1.2.3.1.3 Electrical Load Balance.

a. When three-phase power is used to energize the equipment, the load shall be balanced among the three input phases so the total load on any one phase does not deviate from the average of the three phases by more than 10 percent under normal operating conditions.
b. Single phase, three wire power loads shall be balanced among the legs to within 10%.

3.1.2.3.1.4 Harmonics.

a. The individual current harmonic distortion (I_N) produced by each individual equipment item or subsystem (consisting of several items combined in a single power circuit) shall not exceed the limits listed in Table 1 measured from the equipment end of the electrical power branch feed.
b. The total current harmonic distortion (THD) for equipment or subsystems requiring power of 40 kilowatts or more shall be limited to 10 percent. THD is defined in IEEE STD 519-1992, “IEEE Recommended Practices and Requirements for Harmonic control in Electrical Power Systems”.

TABLE 1. LIMITS OF INDIVIDUAL HARMONICS

Harmonic Order	Maximum Limits (ma) For 50<W<600 (1 phase)	Maximum Limits (ma) For 600<W<40K (1 of 3 phase)
2	1.00 x W	400 + (0.05 x W)
3	3.60 x W	1440 + (1.20 x W)
4	1.00 x W	400 + (0.05 x W)
5	2.00 x W	800 + (0.66 x W)
6	0.50 x W	200 + (0.02 x W)
7	1.50 x W	600 + (0.05 x W)
8	0.50 x W	200 + (0.02 x W)
9	1.00 x W	400 + (0.33 x W)
10	0.10 x W	100 + (0.01 x W)
11	0.60 x W	240 + (0.20 x W)
12	0.10 x W	100 + (0.01 x W)
13	0.51 x W	203 + (0.17 x W)
14	0.10 x W	50 + (0.01 x W)
15	0.44 x W	176 + (0.15 x W)
16	0.10 x W	50 + (0.01 x W)
17	0.39 x W	155 + (0.13 x W)
18	0.10 x W	50 + (0.01 x W)
19	0.35 x W	139 + (0.12 x W)
20	0.10 x W	50 + (0.01 x W)

NOTES:
1. W equals power in watts.
2. Power is active power in watts for both single phase and polyphase circuits as defined by ANSI/IEEE Standard 100. "IEEE Standard Dictionary of Electrical and Electronics Terms".
3. K equals 1000.

3.1.2.3.1.5 Circuit Protection.

a. Current overload protection for the equipment shall be provided by fuses, circuit breakers, or other protective devices for primary circuits, "upstream" of the wiring and components that are being protected.
   1. Multi-pole circuit breakers shall have an internal trip mechanism; handle ties shall not be allowed.
   2. Overcurrent devices shall have a minimum of 10,000 Ampere Interrupting Capacity (AIC) rating.

b. Devices/components shall be protected from damage due to a loss of power or loss of phase in excess of one (1) second.

c. Overcurrent protective devices shall provide selective fault isolation, rated for the available fault current calculated at the device location.

d. Available fault current shall be calculated from information in the contract concerning the facility in which the equipment/system shall be located.

e. Series combination system overcurrent protection shall not be permitted.

f. Transient protection shall be provided in accordance with U. L. 1449 and ANSI/IEEE C62.41-1991, specifically surge waveforms per table 2 and include the standard and additional waveforms.

3.1.2.4 Equipment Response to Input Power Conditions.

The equipment shall perform in accordance with the project specification when subjected to any or all of the following power parameters.

a. Voltage

Nominal FAA Voltage	Voltage Range	
208/120 3 Phase	+10%,-15%	
480\277 3 Phase	"	
240/120 3 Phase	"	
120/240 1 Phase	"	
DC 48 Volts	+ or – 20%	AC Ripple less than or = 5%
DC 24 Volts	"	"
DC 12 Volts	"	"

b. Voltage phase imbalance, phase to phase: 2% as defined by IEEE STD 141-1986 Paragraph 3.8.2

$$\text{Phase-voltage unbalance} = \frac{\text{Maximum deviation from average phase voltage}}{\text{average phase voltage}}$$

c. Frequency
1. Steady State
   a. Steady state 60hz +or – 3 hz
   b. Steady state rate of change 1.5 Hz/sec
   c. Steady state frequency variation + or – 0.5hz
2. Momentary deviations (.5 cycles to 3 seconds)
   a. 60 Hz + 5 Hz, - 7 Hz
   b. Rate of change 5hz per sec.

d. Voltage Harmonic Distortion
8% Voltage Total Harmonic distortion (THD)
3% Any one Harmonic

e. Voltage/Time Events: IEEE Standard IEEE C62.41-1991, voltage and current values given by tables 3 & 4 – for appropriate exposure locations per sections 7.3.3 and 8.3 – and table 5, earthed neutrals.

f. For 120 volt single phase applications only, voltage/time events which occur within the ITI CBEMA curve as shown in Appendix 1. The use of the CBEMA curve may be applied to other voltages.

3.1.2.4.1 Performance Upon Fault Condition On Radio Frequency Equipment Output Circuit.

a. All equipment output circuits shall be designed to include circuit protection and to prevent damage to equipment upon occurrences of opens or shorts on the output terminals.
b. When the short or open is removed, circuit performance shall show no sign of performance degradation. In addition, transmitter output circuitry shall be so designed that, when operated at any voltage standing wave ratio (VSWR), the unit shall not be damaged nor shall any part exceed dissipation limits.
c. The transmitter may shut itself down upon detection of a high VSWR.

3.1.2.4.2 Power fail recovery.

a. The equipment/system shall have automatic power failure recovery capability.

b. The return to service shall be less than one minute. *(The Program Office should determine if this requirement is applicable to their project).*

3.1.2.5 Grounding and Bonding.

a. The contractor shall determine the type of ground reference necessary for the equipment/system per NFPA 70, FAA-STD-019, FAA-STD-020, FAA-C-1217 and sections 8 and 9 of IEEE I00-1992. FAA facilities utilize the following ground systems: (I) "multi-point"; (2) "single point"; (3) NEC power; and (4) "transient": as identified in FAA-STD-019.
b. Shielding and bonding shall be per FAA-STD-019 and FAA-STD-020.
c. Rack-mounted Equipment: Any rack-mounted, i.e., drawer type or removable, equipment whose chassis is intended for multi-point grounding shall have a flexible grounding strap or braid connecting each unit, assembly, or subassembly of equipment to the rack, using proper bounding connections per FAA-STD-020.
d. Enclosure and rack doors shall have grounding straps or braids across the hinges to ensure grounding of the door, bonded properly per FAA-STD-020.
e. Isolated ground receptacles shall be wired per NFPA-70.

3.1.2.6 Corona Prevention (High Voltage/High Current).

a. Corona prevention shall be as follows:
   1. When equipment is terminated with the cabling or other accessory equipment with which it is intended to be used, and when operated under the specified service conditions of humidity, temperature, condensation and barometric pressure with the specified power source frequencies and voltages (including commonly recurring transients), the corona level shall be compatible with the specified electromagnetic interference requirements.
   2. The corona level shall not degrade the equipment performance beyond the specified limits and shall not produce long-term degradation of the properties of materials or parts which may cause premature equipment failure.
   3. The corona extinction voltage shall be at least 150 percent of the peak circuit voltage, corresponding to the maximum specified steady-state root mean square supply voltage, at any point which does not involve materials resistant to the effects of corona.
   4. Corona inception and extinction voltages shall be in accordance with ASTM D1868.
   5. Sharp edges and points shall be avoided on all metal parts which are included in high-intensity electric fields. These are elements which contribute to formation of corona discharge.

b. Electrical breakdown prevention shall be as follows:
   1. The equipment shall be designed and manufactured with electrical clearance spacing, leakage (migration/creepage) distances, and insulation levels adequate to prevent electrical breakdown under the specified service conditions of humidity, condensation, barometric pressure, temperature, service life, contamination, and operating voltage (including transients).
   2. Liquid dielectrics, gases other than ambient air, or pressurization to prevent electrical breakdown shall not be used. *(Modification to this requirement may be approved by the Government Program Office)*

3.1.2.7 Test Points and Built-in Test Capability.

Test points and built-in test capabilities shall be provided and shall be in accordance with the following subparagraphs:
a. Requirements
   1. Built-in test equipment devices shall maintain their accuracy under all operating conditions required by the specification.
   2. These devices shall be provided with connections or access for their operational checkout or calibration.
b. Locations
   1. Test points and controls for adjustment shall not be located in compartments with voltage points of 30 volts or more.
   2. All test points and controls for adjustments shall be located to preclude accidental shock to personnel engaged in normal operating or maintenance activities.
c. Protection. Protection shall be provided in the test point circuitry to prevent equipment damage caused by the external grounding of test points.
d. Failures. Provisions for testing shall be so designed that any failure of built-in-test (BIT) devices will not degrade equipment operation or cause equipment shutdown unless equipment is specifically designed to shut down in case of

BIT device failure. ***(The applicability of this requirement is based on the maintainability requirements of the program).***

3.1.3 Mechanical.

3.1.3.1 Furnishing of Removable Parts and Mating Connectors.

a. Each equipment furnished by the contractor shall be complete with an installed set of fuses, lamps, plug-in relays, plug-in crystals, ferrule-type resistors, and other parts which are used in the equipment and which are similarly designed for quick removal and replacement. This requirement does not apply to plug-in parts which provide expanded equipment capabilities not implemented as part of the contract. For example, spare card cage sockets and memory expansion sockets may remain empty unless specifically required otherwise by the equipment specification or statement of work.

b. Parts which may be damaged by shipment in the operating sockets shall be packed in the normal part shipping container along with information to identify the operating socket.

c. Where a coaxial or cable connector is provided on a piece of equipment furnished under the contract which will be connected to another piece of equipment not being furnished under the contract, the contractor shall supply the mating connector for the equipment under contract.

d. When two or more pieces of equipment furnished under the contract require interconnection, the contractor shall supply the necessary mating connectors.

e. Telephone-type plugs and jacks, modular telephone plugs and jacks, and industry standard communications cables (such as RS-232 cables and connectors) are excluded from this requirement.

3.1.3.2 Installation.

The equipment shall be capable of installation, removal and reinstallation without special tools. ***(Special tools required may be approved by the Government Program Office.)***

3.1.3.3 Construction.

The equipment shall be constructed so that:

a. No fixed part shall become loose,

b. The total load from the equipment/enclosure to the floor shall not exceed 125 pounds per square feet.

3.1.3.3.1 Pull-Out Drawers.

a. All equipment pull-out drawers shall be of a full-suspension roller type with latching stops. Friction-slide construction is prohibited.

b. Slides shall be of sufficient rigidity to prevent bowing and/or having rollers jump their track.

c. Drawers shall be equipped with handles to permit withdrawing the drawer into the open position and latches on active panel fasteners to secure the drawer in the closed position.

3.1.3.3.2 Rack Panels.

a. Where rack panels are used, they shall be in accordance with ANSI/EIA 310.

b. Panel slot/hole pattern shall be the universal hole spacing pattern for 1U, 2U, and 3U panels and the wide hole spacing for panels 4U and higher.

c. Nominal thickness for aluminum panels shall be 3/16 inch, or greater.

d. Nominal thickness for steel panels shall be at 1/8 inch or greater.

3.1.3.3.3 Shelf-Life.

Materials and the processes shall ensure the equipment will meet performance requirements for a period of two years in a nonoperational state after Government acceptance.

3.1.3.3.4 Moisture.

a. Equipment in it's operational environment shall not collect moisture.

b. Equipment that collects moisture shall have drainage or purging capability to remove moisture.

c. Removal of moisture shall be considered as part of the Mean Time To Repair (MTTR) calculations.

3.1.3.3.5 Windows.

a. Equipment windows, including dial windows, shall be shatterproof transparent material.

b. Windows shall be secured to the panels in bezels by means of clips or other devices to prevent displacement of the window.

c. If the windows are a Line Replaceable Item (LRI) adhesives shall not be used.

3.1.3.4 Accessibility.

a. Equipment shall be designed for accessibility, operating compatibility, maintenance, electromagnetic compatibility, and enclosure requirements.

b. All non-hinged shields or plates which are normally opened or removed in servicing an equipment, shall be secured with captive fasteners.

c. Captive fasteners shall be spaced on centers not exceeding 10 inches and shall be located around the entire periphery of the shields or plates.

d. Units which are difficult to connect when mounted, shall be capable of movement to a more convenient position for connecting and disconnecting cables.

3.1.3.4.1 Connections.

Connections to parts inside a removable container shall be arranged to permit removal of the container without threading connection leads through the container.

3.1.3.4.2 Parts.

a. LRUs shall be removable and replaceable.

b. LRUs shall not be mounted by means of rivets, spot welding, or hard curing compounds.

c. Where LRU plug-in modules or assemblies are used, they can be inserted in the proper location when correctly oriented without damage to equipment or parts being engaged.

d. LRU plug-in modules and assemblies shall be designed to prevent insertion into the improper location or incorrect orientation.

3.1.3.4.3 Enclosures.

a. Accessibility to chassis, assemblies, or parts contained within cabinets, consoles or other enclosures shall be provided from outside the basic equipment.

b. Mounting such items on withdrawal slides, swinging doors, through cable extenders and cable retractors, and provisions for circuit card extenders shall allow part or module operation in the open position.

c. Locks shall be provided to lock the chassis in the servicing position.

d. When withdrawal slides are used they shall be of guided sectional construction.

e. Complete removal and access for servicing of electronic equipment contained within cabinets, consoles or other enclosures shall be provided from either the front or rear of the equipment.

f. Guide pins (or locating pins), or the equivalent, shall be provided for mechanical alignment during mounting.

3.1.3.5 Thermal Design.

a. The equipment shall be capable of operating in the environment specified.

b. Where forced air cooling is required, air filters shall be provided to protect the electronic equipment.

c. The exhaust air temperature, measured inside the cabinet or console in front of the exhaust air vent, shall not exceed the input air temperature, (measured outside the cabinet or console directly in front of the input air vent,) by more than 15^0C with the equipment operating under normal service conditions.

d. All ventilation openings shall be designed and located to comply with electromagnetic interference, undesired radiation and enclosure requirements.

e. Air exhaust shall be directed away from operating personnel.

f. Cooling methods such as liquid, evaporative coolants, and vapor cycle refrigerants shall not be used.

NOTE: MIL-HDBK-251 may be used as a guide for detail information on thermal design of electronic equipment.

3.1.4 Maintenance of Onboard Software & Data.

a. Any maintenance, modification,and/or replacement of onboard software programs and data (including embedded software and data in, e.g., PROMS) shall be accomplished via electronic means and shall not require the removal and/or replacement of any electronic component or subsystem.

b. Each system containing maintainable onboard software programs and data (including embedded software and data in , e.g., PROMS) shall contain the functional means for accomplishing the maintenance, modification, and/or replacement.

3.1.5 Remote Maintenance Monitoring.

Remote maintenance monitoring (RMM) shall be in accordance with the equipment system/subsystem specification requirements.

3.2 Characteristics.

3.2.1 Performance.

3.2.1.1 Environmental Conditions.

3.2.1.1.1 Environmental Design Values.

3.2.1.1.1.1 Operating Conditions.

a. The equipment shall operate in one of the environments specified in Table 2.

TABLE 2. ENVIRONMENTAL CONDITIONS

ENVIRONMENT (note 1)	TEMP. (^{O}C)	REL HUM. (%) (note 3)	ALTITUDE (ft above sea level)	WIND (mph)	ICE LOADING
I	+10 to +50	10 to 80	-300 to 10,000	-	-
II	-10 to +50	5 to 90	-300 to 10,000	-	-
III (note 4)	-50 to +70	5 to 100	-300 to 10,000	0 to100	Encased in ½" radial thickness clear ice
IV	+10 to +40	30 to 80	0 to 8,000		

NOTES: 1.

I. For equipment installed in an attended facility.
II. For equipment installed in an unattended facility.
III. For equipment installed outdoors (antennas, field detectors, etc.).
IV. For equipment installed in controlled environment.

2. Includes 18^{o}C for solar radiation.
3. Above 40^{o}C, the relative humidity shall be based upon a dew point of 40^{o}C.
4. See Paragraph 3.3.1.3.6.

b. For outdoor environments shown in Table II, the equipment shall withstand the combined wind and ice conditions without permanent deformation or change that would impact upon critical performance parameters.

(NOTE: Environmental testing will be as specified in the equipment specification or statement of work.)

3.2.1.1.1.2 Non-Operating Conditions.

Equipment to be delivered to the government packaged for storage, shipping or transporting (non-operating) shall, as packaged, withstand the following environmental conditions:

(a)	Temperature	-50C to +56C
(b)	Relative humidity	Up to 100% including condensation due to temperature changes
(c)	Altitude	0 to 50,000 feet above sea level

3.2.1.2 Stability.

After initial adjustment, equipment shall operate within specified limits for a period of not less than six (6) months.

3.2.2 Physical Characteristics.

3.2.2.1 Electronic Equipment Assembly Requirements.

Equipment assemblies, subassemblies, printed wiring assemblies, terminal board assemblies, electronic modules, etc., shall be Class 2 or Class 3 as defined in ANSI/J-STD-001B. *(Note: The Government Program Office needs to determine which Class is appropriate.)*

3.2.2.1.1 Component Mounting.

Component mounting shall be in accordance with IPC-CM-770 or IPC-CM-780, as applicable, except the term 'not recommended' shall be interpreted as 'reject'.

3.2.2.1.2 Printed Boards.

Printed boards shall be in accordance with IPC-A-600.

3.2.2.1.3 Assembly.

Assembly shall be in accordance with ANSI/IPC-A-610 and ANSI/J-STD-001B.

3.2.2.2 Wire Wrap.

Wire wrap shall not be used on printed circuit. *(Note: The Government Program Office may modify this requirement.)*

3.2.3 Reliability.

The equipment reliability shall meet the availability requirements stated in the FAA NAS SR-1000.

3.2.4 Maintainability.

a. Where components are selected in the power and electronic areas of the equipment, unit or system, preference shall be given to components that have predicted service life availability.

b. No movable part or permanently set adjustment shall shift its setting or position.

c. For routine servicing and maintenance, unsoldering of wires, wire harnesses, parts or assemblies shall not be required in order to gain access to terminals, soldered connections, mounting screws and the like.

d. If, in order to check or remove a part, it is necessary to displace some other part, the latter part shall, whenever practicable, be so wired and mounted that it can be moved without being disconnected and without causing circuit detuning or instability.

e. No unsoldering or soldering of connections shall be necessary when the front panel or any subchassis is removed for maintenance purposes.

f. Shutdown of fans shall not be required for replacement of air filters.

g. The equipment shall have a mean time to repair (MTTR) of no greater than 0.5 hours.

h. The equipment shall have a maximum time to repair of no greater than 1.5 hours.

(Note: The mean time between critical failure shall be determined by the Government Program Office.)

3.2.5 Operational Failure.

The equipment shall be designed so that any failure in the equipment shall cause the equipment to go off-line.

3.2.6 Fail-soft Remote Maintenance Monitor Operation.

Failure of the RMM system shall not affect the operation of other equipment.

3.2.7 Electrostatic Discharge.

No system failures or service interruptions shall occur due to electrostatic discharge under the following conditions:

a) While in an non-operating state, when subjected to either a voltage discharge of 12kV, as stored in a 100 pf capacitor and discharged to the equipment case through a series impedance of 100 ohms, or a transient current with an energy content of 7.2 millijoules.

b) During operation, when subjected to either a voltage discharge of 7kV, as stored in a 100 pf capacitor and discharged to the equipment case through a series impedance of 500 ohms, or a transient current with an energy content of 2.45 millijoules.

3.3 Equipment Design and Construction.

The equipment shall be designed to meet the requirements of the equipment specification and as specified herein.

3.3.1 Materials, Processes, and Parts.

3.3.1.1 Materials.

3.3.1.1.1 Dissimilar Metals.

a. Selection of metals for use in electronic equipment shall be made in accordance with the requirements of MIL-STD-889.

b. Where electronic design requirements preclude the insulation of incompatible metal combinations as identified in MIL-STD-889 from one another, specific attention shall be paid to isolating the combination from exterior environments.

3.3.1.1.2 Metals, Corrosion Resistance.

a. Metals shall be corrosion resistant or shall be coated or metallurgically processed to resist corrosion.

b. Materials and processes for metallic parts shall conform to applicable requirements in MIL-STD-889 and MIL-HDBK-1516.

c. Coatings shall be selected from MIL-HDBK-1516.

d. Non-corrosion resistant steel alloys, except where specifically required for electronic purposes shall not be used.

3.3.1.1.2.1 Corrosion-resisting Ferrous Alloys.

a. Austenitic corrosion-resisting steel shall be used for all structural parts which will be subjected to severe corrosive conditions, such as exposure to sea water and combustion gases.

b. Corrosion-resisting steels shall be given a passivation treatment.

c. Other protective finishes or platings are permitted for electrical or mechanical reasons.

3.3.1.1.3 Flammable Materials.

Materials used shall, in the end item configuration, be noncombustible or fire retardant in the most hazardous conditions of the equipment environment.

3.3.1.1.3.1 Additives.

a. Fire retardant additives may be used provided they do not adversely affect the specified performance requirements of the basic materials.

b. Fire deterrents shall not be achieved by use of nonpermanent additives to the basic material.

3.3.1.2 Equipment Manufacturing Processes.

3.3.1.2.1 Strain Relief.

Each part lead terminating at a connection point shall have allowance for strain relief to minimize tensile or shear stress.

3.3.1.2.2 Painted Finish.

a. Metal surfaces not otherwise protected as described herein shall be painted.

b. The painted surfaces shall withstand the environmental conditions defined by the equipment specification.

c. Painted finish shall be in accordance with FAA-STD-001. *(Note: The Government Program Office needs to determine if this requirement is applicable.)*

d. Leaded paint or paints containing isocynates and hazardous substances shall not be used.

3.3.1.2.3 Cadmium Plating.

(Note: The FAA has grave concerns on the use of cadmium.)

a. Cadmium plating shall not be used if it is in direct contact with other FAA equipment, located in confined spaces adjacent to waxes, phenolics, or other organic materials which will react with the cadmium to cause growth or the formation of cadmium soaps.

b. Cadmium plating shall not be used if the surface is subjected to wear from friction. *(Note: This requirement addresses with the cancerous hazards or risks of cadmium.)*

c. Cadmium plating shall be in accordance with Type II, Class 1 of QQ-P-416 plating with the following exceptions:

1. Bolts, studs, washers, nuts, and articles with portions externally threaded. These parts have a minimum of class 3 thickness.

2. Parts whose dimensional tolerances will not permit a class 2 thickness shall be given the maximum thickness of plating compatible with dimensional tolerances.

3. Holes, recesses, internal threads, and other areas where a controlled deposit cannot be obtained normally shall not be subject to a thickness requirement.

4. Corrosion-resistant internal-threaded inserts, or protective antiseize compounds, or internal threads, shall be used where necessary in cadmium-plated parts.

3.3.1.3 Electrical Parts.

3.3.1.3.1 Batteries.

a. Batteries shall not be used unless specifically required by the equipment specification, and shall be in accordance with the following.

1. Batteries shall have operate a minimum of 2 years before requiring replacement.
2. The replacement of the batteries shall not exceed 30 minutes
3. Batteries shall meet the safety requirements of OSHA.
4. Battery back-up time shall be as specified in the System Level Specification.
5. Batteries shall not leak or generate toxic, corrosive or combustible fumes.

3.3.1.3.1.1 Installation Marking.

Connections, polarity, minimum acceptable voltage for equipment operation, nominal voltage, and type(s) of batteries required shall be marked as applicable in a prominent place on or adjacent to the battery compartment.

3.3.1.3.2 Circuit Breakers.

3.3.1.3.2.1 Selection and Application.

a. Circuit breakers shall be selected based on the environmental conditions specified in the System Level Specification.

b. Circuit breakers shall conform to W-C-375.

c. Trip-free circuit breakers shall be used unless otherwise specified or approved by the government program office.

d. Circuit breakers shall be compatible with the equipment full load current, inrush current and harmonic loads encountered.

e. Circuit breakers shall be capable of being manually operated to the ON and OFF positions.

f. Circuit breakers shall not be used as ON/OFF switches unless they have been specially designed and tested for that type of service.

g. Circuit breakers shall have easily identified ON, OFF and TRIPPED positions except that the TRIPPED position may be the same as the OFF position with no differentiation between OFF and TRIPPED being required.

3.3.1.3.3 Electrical Connectors.

LRU to LRU electrical connectors shall function in the environmental conditions required in the System Level Specification.

3.3.1.3.3.1 Selection.

a. Selection and use of electrical connectors shall be in accordance with applicable recognized industry standards.

b. Intended use information contained in the individual connector specifications shall be considered prior to making connector selections.

c. Contact crimp, installing, and removal tools shall be in accordance with the individual connector specifications.

d. Tools shall be selected from the FAA tools list. *(Note: The Government Program Office needs to determine if this requirement is applicable.)*

e. Electrical connectors shall be capable of being maintained and repaired on site with a mean time to repair of no more than 1.5 hours.

3.3.1.3.3.2 Connectors with Thermocouple Contacts.

a. All connectors used in conjunction with thermocouples shall have their contact materials identified by one of the following methods:

   1. Nameplate securely attached to each connector half or mounted on the panel mounted receptacles.

   2. By means of insulation sleeving or other markers designed for attachment around wire bundles.

b. Markers shall be attached adjacent to the plug.

c. Contact materials shall be identified with abbreviations in accordance with Table 3.

TABLE 3. ABBREVIATIONS FOR THERMOCOUPLE MATERIALS	
Chromium	CR
Cobalt	CO
Alumel	AL
Tungsten Rhenium	W RE
Iron	FE
Tungsten	W
Constantan	CN
Iridium	IR
Copper	CU
Rhodium	RH
Platinum	PT
Iridium Rhodium	IR RH
Platinum Rhodium	PT RH
Molybdenum	MO
Rhenium	RE
Gold	AU

3.3.1.3.3.3 Power Connectors.

a. All power connectors shall be in accordance with NEMA standards.

b. Polarized connectors are required and shall be used where automatic grounding must be provided to ensure safety to equipment and personnel.

3.3.1.3.3.4 Protective Measures.

a. All unmated connectors shall be protected with metal or plastic caps or otherwise suitably protected during maintenance, storage and shipment.

b. Unmated connectors with exposed contacts which may contain electrically hot shall be covered with moistureproof and vaporproof caps.

3.3.1.3.4 Fuses, Fuseholders, and Associated Hardware.

3.3.1.3.4.1 Selection.

a. Fusing shall be arranged so that fuses in branch circuits will open before the fuses in the main circuit.

b. Fuses shall not perform the function of thermal overload relaydevices.

a. Fuse ratings shall be compatible with both starting and operating currents.

d. All fuses shall be easily replaceable in 5 minutes.

e. Connections to extractor post type fuse holders shall be such that the load is connected to the fuse terminal which terminates in the removable cap assembly.

3.3.1.3.5 *Indicating Meters.*

a. Meters shall be panel type electrical indicating instruments in accordance with ANSI Standard C39.1.
b. The accuracy of the meters for any measurement shall be 10 times more accurate for the maintenance.

3.3.1.3.6 Printed Wiring Board Modification.

Modifications to printed wiring boards i.e., the use of cuts and/or jumpers or any other changes are not authorized.

3.3.1.3.7 Conformal Coating of Printed Circuit Boards

a. Conformal coating shall be used when equipment is exposed to salt atmosphere or located in tropical climate.
b. When conformal coating is required, coating material shall conform to MIL-I-46058.

3.3.1.3.8 Electromagnetic Shielding.

a. Magnetically sensitive devices shall be shielded to control the effects of electromagnetic fields.

b. Such devices shall be protected to ensure that their performance will not be degraded beyond equipment specification limits, by fields external to the equipment, nor produce emissions in excess of the specified operating limits per commercial specification as appropriate to the environment.

3.3.1.3.9 Switches.

Switches shall provide a positive action without an incidental action.

3.3.1.3.10 Wiring.

The selection, application, and wiring practices for cable and wire shall be in accordance with the following subparagraphs:

3.3.1.3.10.1 Clearance and Leakage (creepage) Distances.

Clearance between solder connections or bare conductors (such as terminal strips, stand offs or similar connections), shall not allow accidental contact occurring between adjacent connections when subject to service conditions specified in the equipment specification. (For electrical clearance and leakage distances, see Table 4.)

TABLE 4. ELECTRICAL CLEARANCE AND LEAKAGE (CREEPAGE) DISTANCES

VOLTAGE AC (RMS) OR DC	CLEARANCE		LEAKAGE DISTANCE (inches)	
	CONDITION	INCHES	ENCLOSURE I	ENCLOSURE II
To 150	A B C	1/16 1/8 1/4	1/16 1/8 3/8	1/16 1/4 3/4
150-300	A B C	1/16 1/8 1/4	1/16 1/8 1/2	1/16 1/4 3/4
300-600	A B C	1/16 1/8 1/4	1/8 1/4 1/2	1/8 1/4 3/4
600-1000	A B C	1/8 1/4 1/2	1/8 1/4 1-1/2	1/2 1 2

Notes:

1. Condition A is for use where the effect of a short circuit is limited to the unit; and where normal operating power does not exceed 50-watts.
2. Condition B is for use where short circuit protection in the form of fuses, circuit breakers, etc, is provided; and where normal operating power does not exceed 2000 watts.
3. Condition C is for use where short circuit protection in the form of fuses, circuit breakers, etc, is provided; and where normal operating power exceeds 2000 watts.
4. Enclosure I is an equipment enclosure which has no openings or the openings are constructed so drops of liquid or solid particles striking the enclosure, at any angle from 0 degrees to 15 degrees from the vertical, cannot enter the enclosure directly or by striking and running along a horizontal or inwardly inclined surface.
5. Enclosure II is any equipment enclosure which provides less protection than Enclosure I.

3.3.1.3.10.2 Marking/Labeling.

a. All signal, control and power wiring shall be uniquely identified to and within the enclosure along the wire and at each termination by either permanent, insulation markings or by heat shrink labels.

b. Marking/labling of the wiring shall occur at structural penetrations and at every 20 feet of wiring.

3.3.1.3.10.3 Wiring Protection.

a. The wiring shall be secured and protected against chafing due to vibration or movement (such as slide out racks or drawers).

b. Wiring to pull-out drawers shall employ cable retractors to protect the equipment.

c. When clamping is used, the cable shall not be degraded.

3.3.1.3.10.4 Insulation Cold Flow.

For insulated wire susceptible to cold flow, care shall be exercised so there will be no cold flow of the insulation.

3.3.1.3.10.5 Cable Ducts.

Where cable ducts are employed, provisions shall be made for the removal of any wire that may become faulty. For example, covers may be employed at intervals to aid in the removal of a faulty wire.

3.3.1.3.10.6 Bend Radius.

The bend radius of wire and cable shall not be less than five times the cable diameter to avoid establishing a permanent set in the cable.

3.3.1.3.10.7 Sleeving.

a. Flexible plastic sleeving, either nonflammable, self extinguishing, or flame retardant, shall be used on cables subject to flexing, such as panel door cables.

b. The sleeving shall be secured under cable clamps at each end.

c. The cable shall be formed and secured so the cable will not be subject to abrasion in its normal flexing motion.

d. In cases where abrasion cannot be avoided, additional protection shall be provided.

3.3.1.3.10.8 Panel Door Cables.

a. Wiring to parts on a hinged door shall be contained in a minimum number of cables, arranged to flex without becoming damaged when the door is opened and closed.

b. Cabling shall be arranged in such a way to maintain access to the equipment.

3.3.1.3.10.9 Through Hole Protection.

a. Whenever wires are run through openings in metal partitions, shields, and the like, which are less than 1/8 inch in thickness, the holes shall be equipped with suitable mechanical protection (grommet) or insulation.

b. Openings in panels 1/8 inch or more in thickness shall have either grommets or the edges of the openings rounded to a minimum radius of 1/16 inch.

c. Grommets for wires operating at RF potentials exceeding 500 volts rms, shall be of ceramic or plastic material of suitable dielectric strength, except for coaxial cables which have outside protection, where rubber or neoprene is acceptable.

d. Insulating grommets are not required for wires or groups of wires passing through shields or other metallic partitions where clearance can be maintained sufficiently to preclude the possibility of accidental contact or damage by abrasion.

3.3.1.3.10.10 Wiring Arrangement.

a. All wiring shall be arranged in a manner to allow access to and maintenance of all components. The use of preformed cables and wiring harnesses is preferred to the point-to-point method of wiring.

b. Where practicable, sensitive circuits in a wire bundle or cable shall not be placed adjacent to a distributing circuit.

c. Materials used for lacing, binding, sleeving, and strapping shall be compatible with the conductor or cable insulation or jacket, and shall meet the same flame retardant and self extinguishing requirements.

d. Wiring shall be arranged to permit bundling or permanently mounted in cable ducts.

3.3.1.3.10.11 Slack.

Discretely terminated wires and cables shall be as short as practicable, except that sufficient slack shall be provided to:

a. prevent undue stress on cable forms, wires and connections, including connections to resiliently support parts.

b. enable parts to be removed and replaced during servicing without disconnecting other parts.

c. facilitate field repair of broken or cut wires.

d. permit units in drawers and slide out racks to be pulled out to the limit of the slide and rotated (if rotatable) or support travel without breaking connections.

e. When drawers or racks are fully extended and rotated (if rotatable), the cable bend radius shall not be less than three times the cable assembly diameter.

f. When flat molded cable assemblies are used, the bend radius shall not be less than ten times the cable assembly thickness.

g. Ensure freedom of motion of contacts or terminals normally intended to have a degree of movement (i.e., floating contacts in connectors).

3.3.1.10.12 Wiring in Terminal Boxes.

Wiring and cables in terminal boxes shall be fanned out to identify terminals for check purposes if test points for required maintenance information are not provided.

3.3.1.3.10.13 Entrance Cabling and Wiring.

Leads from cable entrances to terminal boards, plugs, jacks, and similar devices shall be harnessed and suitably clamped or supported in a cable duct. Flat cable may be used where suitable.

3.3.1.3.10.14 Wire.

Wiring between demarcations shall be continuous. *(Note: Demarcation is at the equipment, termination point or FAA selected.)*

3.3.1.3.10.15 Support.

a. Wire and cable shall be properly supported and secured to prevent undue stress on the conductors and terminals and undue change in position of the wire or cable during and after subjection of the equipment to specified service conditions, or after service or repair of the equipment in a normal manner.

b. When shielding on wire or cable is unprotected by an outer insulation, adequate support is necessary to prevent the shielding from coming in contact with exposed terminals or conductors.

c. Twine or tape shall not be used for securing wire and cable.

3.3.1.3.10.16 Connectors, Insulation Sleeving.

Insulation sleeving of conductors shall be in accordance with standard commercial practices.

3.3.1.3.10.17 Fungus Protection.

a. Fungus protection shall be provided based on the environmental conditions required by the System Level Specification.

b. Prior to attachment of terminals to prepared lengths of cables containing materials that will support fungus, the ends shall be protected against entrance of moisture and fungus by treatment with a fungicidal varnish conforming to MIL-V-173 and in accordance with MIL-T-152.

3.3.1.3.10.18 Aluminum Conductors.

Aluminum conductors shall not be used external to the electronic equipment (LRUs).

3.3.1.3.10.19 Termination of Signal and Control Wiring.

All signal and control wiring external to the electronic equipment shall be terminated with a connector.

3.3.1.3.10.20 Fiber Optics.

Use of fiber optics shall be in accordance with FAA-STD-049.

3.3.1.3.10.21 Raised Floor Cabling.

Cabling under raised floor areas shall be in accordance with section 645-5(d) of the National Electrical Code, NFPA 70.

3.3.1.4 Mechanical Parts.

3.3.1.4.1 Bearing Lubricant.

a. Adequate lubricant shall be provided either within the bearing or externally in the form of oil reservoirs or grease relubrication facilities except as noted herein.

b. Where lubricant replenishment is required, precautions shall be taken to prevent purged or lost lubricant from entering and adversely affecting the operation of the equipment.

c. Where bearings coated with preservative are installed in closed housings, the preservative shall be compatible with the lubricant used in the assembly.

3.3.1.4.2 Controls and Switches.

Controls and switches shall be in accordance with Paragraph 3.3.6.

3.3.1.4.2.1 Direction of Movement.

a. Controls shall be connected in the circuit so the controlled characteristics (e.g., sensitivity, volume, or voltage) increase with clockwise rotation of the control as seen from the operating position.

b. Movement of a control forward, clockwise, right, or up, shall turn the equipment on, or cause the quantity to increase, the equipment to move forward, clockwise, to the right or up.

3.3.1.4.2.2 Operating Controls.

Controls necessary for the operation of the equipment shall be readily accessible, and shall be located on the front panel of the unit.

3.3.1.4.2.3 Adjustment Controls.

a. Adjustment controls that are required for periodic alignment or calibration shall be mounted behind covered openings (such as access doors), and on the faces of the equipment most accessible when installed.

b. When not adjustable by hand, controls shall be designed to accept a common screwdriver blade tip.

c. Controls which infrequently require adjustment need not be accessible from the operating panel, but shall be readily accessible for servicing when the equipment is opened for maintenance purposes.

d. The adjustment range shall not be large enough to cause equipment damage.

3.3.1.4.2.4 Operation.

a. Play and backlash in controls shall be held to a minimum commensurate with intended operational functions and shall not cause poor contact or inaccurate setting.

b. Controls shall operate freely and smoothly without binding, scraping, or cutting. Controls may be lubricated when lubrication does not interfere with operation and is specified in the detail equipment specification.

c. Normal settings of all continuously variable controls shall not fall in the first tenth or last tenth of angular rotation.

3.3.1.4.2.5 Stops.

a. Mechanical stops shall be provided for all adjustable controls, except controls designed for unlimited rotation.

b. Stops shall be provided on the driving end of the shaft where flexible control shafts are employed, or where stops that are integral to the adjustable control or the mechanism could be damaged by excessive torque.

3.3.1.4.2.6 Locking Devices.

a. Control locking devices shall retain the controls in any given setting within the range of control.

b. The locking and unlocking action shall be easily and quickly accomplished, and shall not affect the setting of the control.

c. When in the unlocked position, the locking devices shall not interfere with the normal operation of the control.

d. Where vernier controls are used, the locking devices shall operate on both main and vernier controls if necessary to prevent damage.

3.3.1.4.2.7 Non-turn Devices.

All non-turning controls and bodies or cases of turning controls shall be equipped with a positive device to prevent their turning in the panel or in the assembly on which they are mounted.

3.3.1.4.2.8 Shafts and Couplings.

a. Control shafts and couplings shall be of design and strength commensurate with their respective loads.

b. Coupling between or to shafts shall be accomplished by means of metallic or insulated couplings rigidly secured.

c. Shafts subject to removal may have their couplings secured by two set screws 90 to 120 degrees apart.

d. Flexible couplings will be permitted for controls where the use of rigid couplings would interfere with the satisfactory operation or mounting of such controls.

e. Flexible couplings shall not be employed for frequency determining circuits.

3.3.1.4.3 Fastener Hardware.

Fastener hardware shall be in accordance with the following subparagraphs:

3.3.1.4.3.1 General.

a. Fasteners shall be able to be removed and installed without damage to hardware.

b. Fasteners shall remain secure when exposed to equipment operational and environmental stresses.

c. Except for those items designed to be affixed with one fastener, parts shall be secured so failure of a single fastener will not free the part completely.

d. Friction between mating surfaces shall not be employed as the sole means of preventing fixed parts from rotating or shifting.

3.3.1.4.4 Special Tools.

Special tools shall be capable of performing the required functions throughout the life of the equipment they support. ***(Note: The Government Program Office should determine if any special tools are acceptable.)***

3.3.1.5 Miscellaneous Items.

3.3.1.5.1 Glass.

All glass used in the equipment, except for cathode ray tubes, shall be of the shatterproof type and appropriate for the environmental conditions specified by the System Level Specification.

3.3.2 Electromagnetic Compatibility.

(Note: Electromagnetic compatibility requirements of this specification are applicable to the extent defined in the individual equipment or subsystem specification, contract or purchase order.)

a. All radar and RF transmitting equipment shall meet the applicable technical standards specified in the National Telecommunications and Information Administration (NTIA) Manual of Regulations and Procedures for Radio Frequency Management.

b. Equipment shall meet the appropriate Federal Communications Commission (FCC) authorizations as defined in Title 47, Part 2 and Part 15 of the FCC Rules and Regulations.

c. The electromagnetic compatibility requirements shall be as indicated for Ground, Navy in Table V Requirements Matrix of MIL-STD-461 and defined in the appropriate sections of MIL-STD-461. ***(Note: The Government Program office must explicitly state in the system specification the EMI requirements for items labeled "S" in Table V of MIL-STD-461. See MIL-STD-461, paragraph 5.2 for details.)***

d. For all equipment designed for interface and connections to public or private switched telephone networks, the contractor shall obtain FCC Registration in accordance with Part 68 of the FCC Rules and Regulations.

3.3.3 Nameplates and Marking.

3.3.3.1 Nameplates.

a. Each subsystem shall have one or more nameplates determined by the equipment configuration.

b. Each nameplate shall be in accordance with Figure 3.

c. Nameplates shall be attached by removable 4-40 panhead screws.

3.3.3.1.1 Equipment Titles.

a. Unless specifically set forth in the equipment specification, the contractor shall request titles and type designations before preparing and submitting the nameplate drawings to the Contracting Officer.

b. The titles of the equipment specifications shall not be assumed to be the correct equipment titles for use on the nameplates.

3.3.3.1.2 Serial Numbers.

a. Serial numbers shall start with (1) one for each equipment unit having an individual nameplate and continue consecutively up to the total number of such equipment units on the contract.

b. Serial numbers for a given part number shall not be duplicated or reassign by the contract.

3.3.3.2 Marking.

a. A marking shall be permanent and legible during normal operation and maintenance usage.

b. A marking shall be as specified in ANSI/IEEE-200.

3.3.3.2.1 Visibility of Parts Labels.

All LRU parts which have labels or markings identifying data or ratings, shall be mounted so that the data are visible to maintenance personnel without the necessity for disassembly of part or of adjacent functional or structural parts. *(Note: The Government Program Office needs to determine if this requirement is applicable.)*

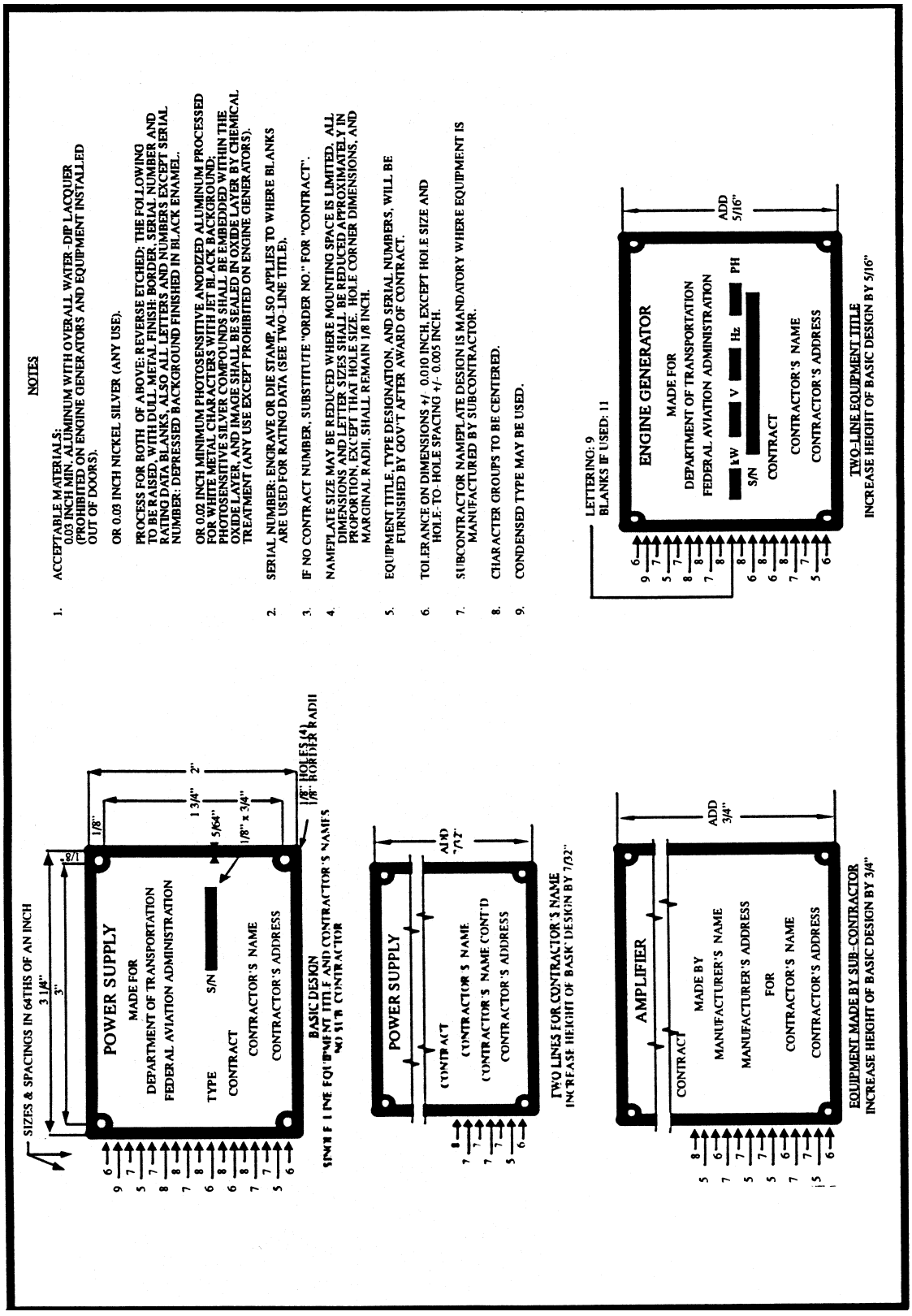


FIGURE IV. STANDARD NAMEPLATE

Figure 3. Standard FAA Nameplate

3.3.3.2.1.1 Fuse Positions.

All fuse positions shall be marked with the rated current capacity of the fuse to be employed therein and approved by the FAA.

3.3.3.2.1.2 Terminal Strips, Blocks and Wafer Switches.

All terminal strips, blocks and wafer switches shall be designated.

3.3.3.2.1.3 Controls and Indicating Devices.

a. Markings shall be provided on the front of each exterior and interior panel and panel door, also on control-mounting surfaces of each chassis, sub-panel, etc., to clearly designate the functions and operations of all controls, fuses, and indicating devices mounted thereon, protruding, or available through access holes therein. This includes all equipment that supports operations and maintenance.

b. All markings shall be located on the panel or chassis in correct relationship to the respective designated items.

3.3.4 Interchangeability.

Items shall be interchangeable in form, fit and function without mechanical adjustment.

3.3.5 Personnel Safety and Health.

a. Equipment shall be constructed with safe clearances, work spaces and other safety factors per NFPA 70, FAA Order 3900.19 and OSHA.

b. To ensure personnel safety, the equipment shall be equipped to be anchored and remain in place during a seismic occurrence as stated in the FEMA National Earthquake Hazards Reduction Program (NEHRP).

c. Equipment design for personnel safety shall be equal to or better than the appropriate requirements of the Occupational Safety and Health Act (OSHA) as identified in Title 29, Part 1910, of the Code of Federal Regulations.

d. Human engineering factors affecting safety shall be coordinated when establishing general or detailed design criteria.

e. The design shall eliminate or mitigate all hazards associated with the following:

   1. Equipment shall conform to applicable UL or other national standards in effect at time of manufacture.

   2. Personnel shall be protected from harm of moving parts when replacing filters.

3.3.5.1 Electrical Safety.

a. A means shall be provided to protect personnel from accidental contact with voltages in excess of 30 volts rms or DC during normal operations or maintenance of the equipment.
   1. After power to the equipment is turned off the equipment shall discharge all potential stored power within 2 seconds.
   2. Personnel shall be protected from circuits greater than 21 mA ac and 80mA dc.

b. The power input side of the switch and the incoming power line connections shall be given physical protection against accidental contact.

3.3.5.1.1 Ground potential.

a. The design and construction of the equipment shall ensure that all external parts, surfaces, and shields, exclusive of antenna and transmission line terminals, are at ground potential at all times during normal operation.

b. Any external or interconnecting cable, where a ground is part of the circuit, shall carry a ground wire in the cable terminated at both ends in the same manner as the other conductors.

c. In no case, except with coaxial cables, shall the shield be depended upon for a current-carrying ground connection.

d. Antenna and transmission line terminals shall be at ground potential, except for radio frequency (RF) energy on their external surfaces.

e. Plugs and convenience outlets for use with metal cased portable tools and equipment shall have provisions for automatically grounding the metal frame or case of tools and equipment when the plug is mated with receptacle, and the grounding pin shall make first, break last.

f. Except for semiconductor and microelectronic devices, all outer metal cases of parts such as capacitors, transformers, relays, etc., shall be at ground potential or covered by an external casing made of insulating material.

g. The external casing shall enclose the original case on all sides except the terminal sides.

h. A point on the electrically conductive chassis or equipment frame shall serve as the common tie point for the static or power ground.

3.3.5.1.2 Hinged or Slide Mounted Panels and Doors.

a. Hinges or slides are not considered adequate grounding paths, therefore doors and panels with hinges or slides shall be grounded by use of a flexible ground strap.

b. A ground shall be considered satisfactory if the electrical connection between the door or panel and the system tie point exhibits a resistance of 0.1 ohm or less and has sufficient capacity to ensure the reliable and immediate tripping of equipment over-current protection devices.

3.3.5.1.3 Shielding.

a. Except where a conflict with grounding requirements would be created, shielding on wire or cable shall be grounded to the chassis or frame.

b. The shielding shall be at a sufficient distance from exposed conductors to prevent shorting or arcing between the conductor and the shielding.

3.3.5.1.4 Bonding in Hazardous Areas.

Electronic equipment that is to be installed in areas where explosive or fire hazards exist, shall be bonded in accordance with NFPA 70.

3.3.5.1.5 Guarding of Radio Frequency (RF) Voltages.

Transmitter output terminals, antennas and other devices that carry sufficient RF voltage that may burn or injure personnel shall be protected from accidental contact.

3.3.5.1.6 Interlocks.

Various equipment designs require different approaches to the use of interlocks Interlocks shall conform to the following:

a. No interlocks are required when all potentials in excess of 70 volts are completely protected with guards or barriers to prevent accidental contact under all conditions of operation or any level of maintenance.

b. Interlocks are required when voltages between 70 and 500 volts are exposed when the access door, cover or plate is opened.

c. Bypassable interlock switches shall be momentary action (spring-return) switches marked "INTERLOCK BYPASS" and are provided to allow interlocked access doors and covers to be opened with a manual latch for "on" position to be operated in the exposed interlock switch, without removing power from the equipment.

d. Bypassable interlocks are allowed for these internal voltages that are allowed to be unguarded only if they are not exposed during direct support or operator maintenance.

e. The bypass switches shall be located so that one person can operate the switch, open the door or cover, and set the manual latch.

f. Non-bypassable interlocks are required for voltage in excess of 500 volts, 100 mA ac or 160 mA dc when the access door, cover, or plate is opened.

3.3.5.1.7 Shorting Rods.

a. Shorting rods shall be provided with all transmitting equipment where voltages are in excess of 70 volts rms or Direct Current (DC).

b. Wherever size permits, shorting rods shall be stored within the transmitting equipment and be permanently attached and readily accessible to maintenance personnel.

3.3.5.1.8 Meter Safety.

a. Meters shall have provisions for overload bypass, or alternate protection to eliminate high voltage potential or current at the terminals in the event of meter failure.

b. In addition, meters shall be provided with protection so that not over 1500V, maximum peak value, shall exist between any terminal of each meter and the metal panel on which it is mounted in the equipment.

3.3.5.1.9 High Voltage Protection.

a. Assemblies operating at potentials in excess of 500 volts shall be completely enclosed from the remainder of the assembly and interlocked in accordance with the requirements herein.

b. Test probe holes may be provided in the barriers or guards where maintenance testing is required.

c. When the operation or maintenance of equipment is employing potentials in the excess of 300 volts peak, the equipment shall be provided with test points so these voltages can be measured at a relatively low potential level, but in no case shall the potential exceed 300 volts peak relative to ground.

d. Test points with voltages above 30 volts shall have the conducting material recessed at a distance no less than the diameter of the probe hole and a minimum of 0.06 inch.

e. If a voltage divider is used, the voltage divider resistance between the test point and ground must consist of at least two equally valued resistors in parallel.

f. Full details shall be given in the instruction book or maintenance manual as to the method used in the equipment to obtain the voltage at the test points.

3.3.5.1.10 High Current Protection.

All power buses supplying 25 amperes or over shall be protected against accidental short circuiting by tools, jewelry or removable conductive assemblies.

3.3.5.1.11 Discharging Devices.

a. Discharging devices shall be provided to discharge high voltage circuits and capacitors unless they discharge to 30 volts within two seconds or less after power removal.

b. These protective devices shall be positive acting, highly reliable, and shall actuate automatically when the case or rack is opened.

c. Shorting bars shall be actuated either by mechanical release or by an electrical solenoid when the door or cover is open.

d. When resistive bleeder networks are used to discharge capacitors, the bleeder network shall consist of at least two equal valued resistors in parallel.

e. The particular discharging device that is chosen must ensure that the capacitor is discharged to 30 volts or less within two seconds.

3.3.5.1.12 Connectors, Electrical.

a. The design of the connector shall be such that the operator is not exposed to electrical shock or burns when normal disconnection methods are used.

b. Exposed pin contacts shall not be energized (hot) after being disconnected from the socket contacts.

3.3.5.2 Radio Frequency (RF)/Microwave, X, and Laser Radiation Limits.

3.3.5.2.1 Applicability of Federal Standards.

The design of all equipment for which a federal standard exists under the Code of Federal Regulations (CFR), Title 21, Chapter I, Subchapter J shall conform to the appropriate federal standard.

3.3.5.2.2 Laser Radiation.

Laser equipment and system design, installation, and written operational and maintenance procedures shall conform to CFR, Title 21, Chapter I, Subchapter J, Part 1040.

3.3.5.3 Switches.

3.3.5.3.1 Safety Switches.

a. Safety switches which deactivate associated mechanical drive units shall be provided for the purpose of disconnecting these units without disconnecting other parts of the equipment.

b. All remotely located units and assemblies shall have provisions to prevent overriding safety switches to allow independent disconnecting in the associated equipment.

3.3.5.3.2 Momentary Override.

Momentary contact switches may be used to override interlocks and permit access to the manual override for efficient servicing.

3.3.5.4 Mechanical Hazards.

a. The design of rack mounted equipment shall locate the center of gravity as low as practical to minimize tipping over.

b. Suitable protection shall be provided to prevent contact with moving mechanical parts such as gears, fans, and belts when the equipment is complete and operating.

c. Sharp projections on cabinets, doors, and similar parts shall be avoided. Doors or hinged covers shall be rounded at the corners and provided with stops to hold them open.

d. Provisions shall be enhanced to prevent accidental pulling out of drawers or rack mounted equipment components which could cause equipment damage and injury to personnel.

e. Equipment power switches shall be so designed and located that accidental contact by personnel will not change the equipment state.

3.3.5.4.1 Mechanical Interconnection.

a. The design shall provide positive means to prevent the inadvertent reversing or mismatching of fittings, couplings, fuel, oil, hydraulic, pneumatic lines, mechanical linkage, and instrument leads and electrical connections.

b. When prevention of mismatching by design considerations is not feasible, coding or marking shall be employed when approved by FAA. Coding and marking will not be approved as a substitute for proper design of items involving explosives, emergency, or safety critical systems.

3.3.5.4.2 Cathode Ray Tubes (CRTs).

Cathode ray tubes shall conform to the requirements of UL 1418.

3.3.5.4.3 Glass Fibers.

Glass fibrous materials shall not be used as the outer covering on cables, wire or other items where they may cause skin irritation to operating or maintenance personnel unless specified in the equipment specification.

3.3.5.5 Markings, Signs, Tags, and Symbols.

3.3.5.5.1 Markings.

a. Guards, barriers, and access doors, covers or plates shall be marked to indicate the hazard which may be reached upon removal of such devices.

b. When possible, marking shall be located such that it is not removed when the barrier or access door is removed.

c. Additionally, warnings of hazards internal to a unit shall be marked adjacent to hazards if they are significantly different from those of surrounding items. Such a case would be a high voltage terminal in a group of low voltage devices.

d. Physical hazards shall be marked with color codes in accordance with ANSI Z535.1 where applicable to electronic equipment.

e. Center-of-Gravity shall be marked on equipment which has a center-of-gravity 50 percent different from the center-of-volume of the chassis.

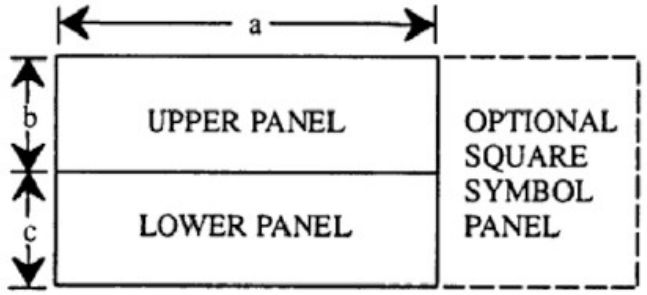
3.3.5.5.2 Accident Prevention Signs and Labels.

a. Accident prevention signs and labels shall be used whenever equipment has characteristics or operating conditions which present a hazard to operators, maintainers, or other personnel. The purpose of such signs and labels is to indicate the nature of the hazard and to provide information so that injury and property damage may be avoided.

b. Signs and labels shall be as permanent as the normal life expectancy of the equipment on which they are affixed.

3.3.5.5.2.1 Sign Design.

a. Signs shall consist of three panels as shown in the following diagram.



General Layout – Two Panel Sign With Optional Symbol Panel

1. The ratio of width to height of the upper panel (a:b) shall fall within the range of 2:1 to 5:1 inclusive.

2. The lower panel shall be equal to the upper panel width (both equal to a).
3. The lower panel height shall be equal to or greater than the upper panel height, but less than twice the width of the sign (b<=c<2a).

4. The optional symbol panel shall be square with its edge equal to the sum of the upper and lower panel (b+c) and placed to the right.
5. The upper panel shall contain the signal or key word.

6. The lower panel shall contain additional direction or explanation. Wording of this panel should be brief, provide positive direction if possible, and be limited to a single hazard.

3.3.5.5.2.2 Sign Classifications and Detailed Design.

3.3.5.5.2.2.1 Class I (Danger).

a. These signs indicate immediate and grave danger or peril, a hazard capable of producing irreversible damage or injury, and prohibitions against harmful activities.

b. These signs shall have the word 'DANGER' in white within a red oval outline with a white on black rectangle in the upper panel.

c. The lower panel, for additional wording, shall be in black or red on a white background.

3.3.5.5.2.2.2 Class II (Caution).

a. These signs are used to call attention to potential danger or hazard, or a hazard capable of or resulting in severe but not irreversible injury or damage.

b. These signs shall have the signal word 'CAUTION' in yellow on a black rectangle in the upper panel. the lower panel, for additional wording, shall be in black on a yellow background.

3.3.5.5.2.2.3 Class III (General Safety).

a. These signs include notice of general practice and rules relating to health, first aid, housekeeping, and general safety other than the two cases above.

b. These signs shall have the appropriate keyword in white on a green rectangle in the upper panel.

c. he lower panel, for additional wording, shall be in black or green on a white background.

3.3.5.5.2.2.4 Class IV (Fire and Emergency).

a. These signs shall be used only to label or point the way to fire extinguishing equipment, shutoffs, emergency switches, and emergency procedures.

b. These signs shall have the keyword in white on a red rectangle in the upper panel.

c. The lower panel, for additional wording, shall be in red on a white background.

3.3.5.5.2.3 Sign placement.

a. Signs shall be placed so as to alert and inform in sufficient time to avoid the hazard or to take appropriate action.

b. Signs shall be placed so as to be readable from a distance commensurate with a. above, create no additional distractions, or be hazards themselves.

c. MIL-STD-1472E shall be used for additional guidance for general label placement.

3.3.5.5.3 Marking of Radioactive Materials.

The marking or labeling of commodities containing radioactive materials shall be in accordance with Nuclear Regulatory Commission Rules and Regulations CFR, Title 10, Chapter I, Part 20 and OSHA Regulation CFR, Title 29, Part 1910.1096.

3.3.5.5.4 Symbols.

The following symbols shall be used as applicable:

a. Ionizing radiation hazard - ANSI N2.1.

b. Microwave and radio frequency radiation - FAA order 3910.3.

c. Laser symbol - CFR, Title 21, Chapter I, Subchapter J, Part 1040.

3.3.5.5.5 Alerts/Warnings.

All warning displays shall provide the operator with a greater probability of detecting the alerts/warnings than normal observation of the equipment would, in the absence of the display.

3.3.5.5.5.1 Audio Warning Signals.

a. Audio signals shall be provided as necessary to warn personnel of impending danger, to alert operators to critical system changes or equipment status, or to remind operators of a critical action which must be taken.

b. An alert/warning signal shall provide an audio intensity such that a signal-to-noise ratio of 20 decibel (dB) is achieved in at least one octave band between 200 and 5,000 Hertz.

c. The resulting intensity shall not exceed the safety levels of Paragraph 3.3.7.1.5.

3.3.5.5.5.2 Display Warnings.

a. Video display warnings shall be provided on equipment with associated video displays to warn operators of impending danger, to alert operators to critical system changes or equipment status, or to remind operators of a critical action which must be taken.

b. Display alert/warnings shall be designed to incorporate clearly discriminative features which distinguish the warning (Color, blink, size, etc.) from other display information.

3.3.5.5.5.3 Battery Warning Label.

Except for equipment requiring permanent battery installation, battery-powered equipment shall be labeled externally as follows:

WARNING
REMOVE
BATTERIES BEFORE
SHIPMENT OR INACTIVE STORAGE
OF 30 DAYS OF MORE

3.3.5.6 Hazardous and Restrictive Materials.

a. Assessment of the hazard potential of a substance and its decomposition products shall be performed prior to material selection.

b. The assessment shall include the relative toxicity of the substance (and decomposition products) as well as the nature of the potential exposure to personnel and equipment.

3.3.5.6.1 Carcinogens.

Certain chemicals have been identified by the Occupational Safety and Health Administration (OSHA) as cancer-producing substances (carcinogens). Before using any materials which might contain these chemicals, they shall be evaluated in accordance with the CFR, Title 29, Chapter XVII, Part 1910.

3.3.5.6.2 Dusts, Mists, Fumes, and Gases.

a. The materials installed in the equipment and under service conditions specified in the specific equipment specification, shall not liberate gases which when combined with the atmosphere form an acid or corrosive alkali, nor shall they generate toxic or corrosive dusts, mists, or fumes which would be detrimental to the performance of the equipment or health of the equipment operators.

b. In addition to equipment operators, gases or fumes shall not be detrimental to plants, fish or wildlife if vented to the outside.

c. The materials also shall not liberate gases which will produce a flammable or explosive atmosphere.

3.3.5.6.3 Restricted Materials.

Mercury and asbestos shall not be used.

3.3.5.6.4 Radioactive Materials.

Use of radioactive materials shall conform to Nuclear Regulatory Commission Regulations and shall require approval of FAA. Radium shall not be used to achieve self-luminosity.

3.3.6 Human Engineering.

General human engineering for design and development of electronics equipment shall be in accordance with this section and MIL-STD-1472E.

3.3.6.1 Noise Criteria Requirement.

a. Noise generated, if not contained indoors, shall conform to local ordinances in accordance with the Noise Control Act of 1972.

b. Operational areas are those areas requiring frequent telephone or radio use or occasional direct verbal communication at distances up to 1.5 M (5 feet). Equipment located in operational areas shall not exceed 55 dB(A). (Operations centers, Control Rooms, Tower Cabs, Dynamic Simulation Rooms.)

c. Equipment areas are those areas requiring occasional telephone use or occasional direct verbal communications at distances up to 1.5 M (5 feet). Such areas may be either manned or unmanned. Equipment located in general work areas shall not exceed 65 dB(A). (Computer rooms, engineering areas, equipment rooms, telephone switching center.)

d. Special areas or offices are those areas requiring no difficulty with direct verbal communications. Operations areas have considerable direct verbal communication. Equipment located in special areas shall not exceed 45 dB(A). (Conference rooms, Operations areas, Libraries, Administrative Offices, Training Classrooms.)

e. Remote areas are those areas located away from operations. These areas are normally unmanned. High noise areas are those areas which exceed 65 dB(A). Equipment located in high noise/remote areas shall not exceed 85 dB(A), unless approved by the FAA.

3.3.6.1.1 Identification of Noise Hazard Areas and Equipment.

a. Noise levels of greater than 85 dB(A) or impulse noise above 120 dB peak pressure level, regardless of exposure time, at operator or crew positions where one or more individuals will be located, including occasionally occupied positions, require that noise caution signs shall be permanently posted on the equipment.

b. Noise caution signs shall be clearly visible and legible to all personnel exposed to the hazard.

c. Operation and maintenance manuals shall address the requirements for hearing protection, type of hearing protection recommended, the noise level of the equipment and the distance at which the 85 dB(A) or 120 dB peak pressure level will be met.

3.3.6.2 Ergonomic Considerations.

Design of equipment shall accommodate the fifth through the ninety fifth percentile male and female user population as stated in MIL-STD-1472E.

3.3.6.3 Weight Lifting Limits.

a. The weight lifting limits shall apply to male and female except where modified by the Government Program Office.

b. The weight lifting limits of Table 5 conditions A and B shall be used as maximum values in determining the design weight of items requiring one person lift with two hands.

c. All multiple weight lifts are addressed in MIL-STD-1472E.

Refer to MIL-STD-1472 for further details.

TABLE 5. DESIGN WEIGHT LIMITS					
	HANDLING FUNCTION	MALE & FEMALE		MALE ONLY	
		kgs	Lbs	kgs	Lbs
A	Lift an object from the floor and place it on a surface not greater than 1.525 m (5 ft) above the floor.	16.8	37	25.4	56
B	Lift an object from the floor and place it on a surface not greater than 915 mm (36 in) above the floor.	20	44	39.5	87
C	Carry an object 10 m (33 ft) or less.	19	42	37.2	82

3.3.6.4 Visual Displays.

Visual displays shall be capable of providing clear indication of equipment condition within the following room illumination levels:

Control Room – 5 to 50 footcandles.
Equipment Room – 50 to 100 footcandles
Air Traffic Control Tower – 5 to 6,000 footcandles
(Note: The Government Program Office should specify the applicable room illumination level(s).)

3.3.6.4.1 Display Information.

a. All information generated by the equipment shall be capable of display to an operator.

b. Information shall be limited to that which is necessary to perform specific actions or to make decisions and shall be selectable by the operator.

c. Numeric digital displays shall not be used as the only display of information when perception of pattern or variation is important to correct comprehension of the information.

d. Numeric digital displays shall not be used when rapid or slow digital display rates inhibit proper understanding.

3.3.6.4.2 Display Positive Feedback.

a. Indication or status displays status shall signify changes in functional status rather than changes in control input.

b. The absence of an indication on status displays shall not be used to indicate critical occurrences (i.e., indicates that the valve has actually closed and not that the button has been pushed or voltage applied).

3.3.6.4.3 Light-emitting Diodes (LED) Displays.

a. LEDs may be used for transilluminated displays, including legend and simple indicator lights, and for matrix (alphanumeric) displays.

b. LED colors shall be chosen to conform with the following; i.e. green good, ok, on; yellow/amber warning, in use; red danger, error, off nominal.

3.3.6.4.4 Flash.

a. The use of flashing indicators or CRT areas shall be minimized. Flash shall be used only when it is necessary to call attention to some condition requiring immediate attention.

b. The flash rate shall be between 3 and 5 flashes per second with approximately equal on and off times.

c. Flashing lights or CRT areas which could flash at the same time shall be synchronized so that they flash on together.

3.3.6.5 Labeling.

a. Labels, legends, placards, signs, tags, markings or a combination of these shall be provided to identify, interpret, follow procedures, or avoid hazards.

b. Labels and information shall be oriented horizontally, placed near the items they identify, placed and grouped to avoid confusion, and placed in a consistent fashion.

c. Labels shall be brief, use words familiar to operators, be easily readable from distances expected with the equipment's use, not covered with tags or obscured by components, and have contrasting background color from the equipment.

d. Label characters shall conform with MIL-STD-1472E Paragraph 5.5.5.

4 QUALITY ASSURANCE PROVISIONS

4.1 Quality System Requirements.

Quality Assurance concepts shall be considered in all aspects of the acquisition process.

A quality system shall be defined, implemented and maintained by the contractor in accordance with the requirements of the appropriate ISO-9000 Quality Assurance Standard as specified in the contract.

4.1.1 Material Evaluation.

Material evaluations normally consist of certification by the manufacturer and are supported by verifying data that all materials which become part of the finished product are in accordance with the specified requirements.

4.1.2 Quality Conformance Evaluation.

Quality conformance evaluations verify that the product/equipment is in accordance with the specified requirements.

Quality conformance evaluations may include, but not be limited to, visual inspections and functional testing.

4.2 Verification/Compliance to Requirements.

4.2.1 Requirements Verification Matrix.

All requirements stated in section 3 shall be verified by either demonstration, inspection, testing or analysis as listed in Table 6, Requirements Verification Matrix. It is understood that certified documentation of previous activities may be an acceptable substitute for performing any of the verifications listed.
The following definitions apply to the table entries:

1. Demonstration (denoted by “D” in table): Verifying the presence of a function or capability in an item by displaying the results of the function being performed. This activity is similar to testing, as it requires a formal procedure, but no quantitative data recorded.
2. Inspection (denoted by “I” in the table): Verifying the required characteristics by means of observation. Observation includes seeing with the aid of tools that magnify.
3. Test (denoted by “T” in table): Verifying the presence of a function or capability in an item by performing a formal procedure to collect quantitative data in a controlled environment.
4. Analysis (denoted by “A” in the table): Verifying the presence of a function or capability in an item by examining the action performed using mathematical, physical, or chemical principles.

TABLE 6. REQUIREMENTS VERIFICATION MATRIX			
Requirement	Paragraph Number	COTS	Other
Physical requirements	3.1.2.2	N/A	N/A
Physical construction	3.1.2.2.1	N/A	N/A
Accessibility for use of maintenance equipment	3.1.2.2.1 a.1	I,D	I,D
Front panel controls and indicators	3.1.2.2.1 b.1	I	I
Disconnection by cord	3.1.2.2.1 b 2.	D	D
Plugs, receptacles, and power cords	3.1.2.2.1 c.	I	I
3-wire Plugs and receptacles	3.1.2.2.1 c.1	I	I
Cord & plug type for detachable cords	3.1.2.2.1 c.2	I	I
Locking type plugs	3.1.2.2.1 c.3	I	I
Power cord rating	3.1.2.2.1 c.4.	I	I
Convenience outlets	3.1.2.2.1 d.	T	T
Segregate power source	3.1.2.2.1 e.	T	T
Power performance requirements - Facility modifications	3.1.2.3	I	I
Load power characteristics	3.1.2.3.1	N/A	N/A
Power factor	3.1.2.3.1.1 a., b., c., d.	T	T
Inrush current	3.1.2.3.1.2 a., b., c., d.	T	T
Electrical load balance – 3 phase equipment	3.1.2.3.1.3 a	T	T
Electrical load balance – single phase equipment	3.1.2.3.1.3 b	T	T
Harmonics	3.1.2.3.1.4	N/A	N/A
Harmonics, individual	3.1.2.3.1.4 a	T	T
Harmonics, total	3.1.2.3.1.4 b	T	T
Circuit protection	3.1.2.3.1.5	N/A	N/A
Overload protection	3.1.2.3.1.5 a	D	D
Multi-pole circuit breakers	3.1.2.3.1.5 a.1	I,T	I,T
Rating, AIC	3.1.2.3.1.5 a.2	I	I
Loss of phase relationships	3.1.2.3.1.5 b	I,D	I,D
Rating, overcurrent devices	3.1.2.3.1.5 c	T	T
Available fault current calculation	3.1.2.3.1.5 d	A	A
Series combination protection	3.1.2.3.1.5 e	A	A
Transient protection	3.1.2.3.1.5 f	T	T
Equipment response to input power conditions	3.1.2.4	N/A	N/A
Voltage	3.1.2.4 a.	T	T
Voltage unbalance	3.1.2.4 b.	T	T
Frequency, steady state	3.1.2.4 c.1.a	T	T
Frequency, rate of change	3.1.2.4 c.1.b.	T	T
Frequency, variation	3.1.2.4 c.1.c.	T	T
Frequency, momentary variations	3.1.2.4 c.2.a	T	T
Frequency, momentary rate of change	3.1.2.4 c.2.b	T	T
Harmonics, voltage total	3.1.2.4 d	T	T
Voltage/time events	3.1.2.4 e	T	T
ITI Curve	3.1.2.4 f.	T	T
RF output circuit protection	3.1.2.4.1 a	D	D
RF output short circuit survivability	3.1.2.4.1 b.	D	D
Transmitter shutdown	3.1.2.4.1 c.	D	D
Power failure recovery capability	3.1.2.4.2 a.	D	D
1 minute recovery after power restoration	3.1.2.4.2 b.	T	T
Grounding and bonding	3.1.2.5	N/A	N/A
Ground type selection	3.1.2.5 a.	A	A
Shielding and bonding	3.1.2.5 b.	I	I
Rack mounted equipment	3.1.2.5 c.	I	I
Grounding straps on doors	3.1.2.5 d.	I	I
Isolated ground receptacles	3.1.2.5 e.	T	T
Corona prevention (High voltage/high current)	3.1.2.6	N/A	N/A
EMI compatibility requirement	3.1.2.6 a.1.	T	T

TABLE 6. REQUIREMENTS VERIFICATION MATRIX			
Corona degradation of material	3.1.2.6 a.2.	T	T
Corona extinction voltage >150% peak circuit voltage	3.1.2.6 a.3.	T	T
Corona inception and extinction voltages per ASTM D1868	3.1.2.6 a.4.	T	T
Corona no sharp edges or points	3.1.2.6 a.5.	I	I
Electrical breakdown	3.1.2.6 b.1.	A,I	A,I
Breakdown prevention methods	3.1.2.6 b.2.	I	I
Test points and built-in test capability	3.1.2.7	N/A	N/A
BIT equipment stability	3.1.2.7 a.1.	T	T
Access points	3.1.2.7 a.2.	T	T
300v near test points and adjustments	3.1.2.7 b.1	I	I
No personnel shock hazard	3.1.2.7 b.2	I	I
No damage from grounding test points	3.1.2.7 c.	D	D
BIT failures do not impact operational functions	3.1.2.7 d.	D	D
Mechanical	3.1.3	N/A	N/A
Furnishing of removable parts and mating connectors	3.1.3.1	N/A	N/A
All parts in place	3.1.3.1 a.	I	I
Parts packing	3.1.3.1 b.	I	I
Mating connectors (interconnection not required)	3.1.3.1 c.	I	I
Mating connectors (interconnection required)	3.1.3.1 d.	I	I
Telephone jack exclusion	3.1.3.1 e.	I	I
Installation - No special tools	3.1.3.2	D	D
Construction	3.1.3.3	N/A	N/A
No fixed part comes loose	3.1.3.3 a.	D	D
Floor-loading (<125#/ft^2)	3.1.3.3 b.	T	T
Pull-out draws	3.1.3.3.1	N/A	N/A
Full suspension rollout drawers	3.1.3.3.1 a	I	I
Rigid slides	3.1.3.3.1 b.	I,D	I,D
Drawer handles and latches	3.1.3.3.1 c	I,D	I,D
Rack panels	3.1.3.3.2	N/A	N/A
ANSI/EIA 310 Rack Panels	3.1.3.3.2 a.	I	I
Universal spacing of panel slot/holes	3.1.3.3.2 b.	I	TI
3/16 in. aluminum panel thickness	3.1.3.3.2 c.	I	I
1/8 in. steel panel thickness	3.1.3.3.2 d.	I	I
Shelf-life	3.1.3.3.3	A	A
Moisture	3.1.3.3.4	N/A	N/A
No moisture collection	3.1.3.3.4 a.	D	D
Drain holes	3.1.3.3.4 b	I	I
MTTR includes moisture removal time	3.1.3.3.4 c.	T	T
Windows	3.1.3.3.5	N/A	N/A
Shatterproof windows	3.1.3.3.5 a.	T	T
Windows do not move	3.1.3.3.5 b.	D	D
No adhesives if LRI	3.1.3.3.5 c.	I	I
Accessibility	3.1.3.4	N/A	N/A
Equipment design	3.1.3.4 a.	A	A
Captive fasteners on non-hinged shields/plates	3.1.3.4 b.	I	I
Captive fastener placement	3.1.3.4 c.	I	I
Accessibility to cable connections	3.1.3.4 d.	D	D
Parts connections inside removable container	3.1.3.4.1	D	D
Parts	3.1.3.4.2	N/A	N/A
LRU shall be replaceable and removable	3.1.3.4.2 a.	D	D
No rivets, welding, etc	3.1.3.4.2 b.	I	I
LRU removal and replacement without damage	3.1.3.4.2 c.	D	D

TABLE 6. REQUIREMENTS VERIFICATION MATRIX			
Fit only in correct slot	3.1.3.4.2 d.	D	D
Enclosures	3.1.3.4.3	N/A	N/A
Accessibility to chassis, assemblies, etc	3.1.3.4.3 a.	D	D
Operation in open position	3.1.3.4.3 b.	D	D
Locks	3.1.3.4.3 c.	D	D
Guided sectional constructed slides	3.1.3.4.3 d.	I	I
Front or rear access for maintenance	3.1.3.4.3 e.	D	D
Alignment mechanisms	3.1.3.4.3 f.	D	D
Thermal Design	N/A	N/A	
Operates in operating environment	3.1.3.5 a.	T	T
Air filters with forced air cooling	3.1.3.5 b.	I	I
Cabinet temperature rise <15 deg C	3.1.3.5 c.	T	T
EMI integrity of ventilation openings	3.1.3.5 d.	T	T
Exhaust air directed away from personnel	3.1.3.5 e	D	D
Forbidden cooling methods	3.1.3.5 f.	I	I
Maintenance of onboard software & data	3.1.4	N/A	N/A
Embedded software updates	3.1.4 a.	D	D
Functional means to maintain onboard software	3.1.4 b.	D	D
RMM per system specification	3.1.5	A	A
Characteristics	3.2	N/A	N/A
Performance	3.2.1	N/A	N/A
Environmental conditions	3.2.1.1	N/A	N/A
Environmental design values	3.2.1.1.1	N/A	N?A
Environmental operating conditions table	3.2.1.1.1.1 a.	T	T
Wind and ice	3.2.1.1.1.1 b.	T	T
Non-operating environmental conditions	3.2.1.1.1.2 (a), (b), (c)	T	T
Stability	3.2.1.2	D	D
Physical characteristics	3.2.2	N/A	N/A
Electronic equipment assembly requirements	3.2.2.1	I,T	I,T
Component mounting	3.2.2.1.1	I	I
Printed boards	3.2.2.1.2	I,T	I,T
Assembly	3.2.2.1.3	I,T	I,T
Wire wrap	3.2.2.2	I	I
Reliability	3.2.3	A	A
Maintainability	3.2.4	N/A	N/A
Predicted service life availability preference	3.2.4 a.	I	I
Rigidity of parts and adjustments	3.2.4 b.	D	D
Routine servicing and maintenance	3.2.4 c.	I,D	I,D
Functional stability of displaced parts	3.2.4 d.	D	D
No soldering when removing sub-chassis	3.2.4 e.	D	D
Air filter replacement	3.2.4 f.	D	D
MTTR>0.5 hours	3.2.4 g.	D	D
Maximum time to repair	3.2.4 h.	A	A
Operational failure	3.2.5	D	D
Fail-soft RMM operation	3.2.6	D	D
Equipment design and construction	3.3	N/A	N/A
Materials, processes, and parts	3.3.1	N/A	N/A
Materials	3.3.1.1	N/A	N/A
Dissimilar metals	3.3.1.1.1 a.	I	I
Environmental isolation of dissimilar metals	3.3.1.1.1 b.	I	I
Metals, corrosion and resistance	3.3.1.1.2	N/A	N/A
Corrosion resistant coating	3.3.1.1.2 a.	A,I	A,I
Materials and processes for metallic parts	3.3.1.1.2 b.	I	I
Corrosion resistant coating selection	3.3.1.1.2 c.	I	I
Non-corrosion resistant steel alloys	3.3.1.1.2 d.	I	I
Corrosion-resisting ferrous alloys	3.3.1.1.2.1	N/A	N/A

TABLE 6. REQUIREMENTS VERIFICATION MATRIX			
Use of austenitic corrosion-resisting steel	3.3.1.1.2.1 a.	I	I
Passivation treatment of corrosion-resistant steels	3.3.1.1.2.1 b.	I	I
Other protective finishes	3.3.1.1.2.1 c.	I	I
Flammable materials	3.3.1.1.3	I	I
Additives	3.3.1.1.3.1	N/A	N/A
Fire retardant additives	3.3.1.1.3.1 a.	A,I	A,I
Permanence of fire deterrent additives	3.3.1.1.3.1 b.	A	A
Equipment manufacturing processes	3.3.1.2	N/A	N/A
Strain relief	3.3.1.2.1	I	I
Painted finish on metal surfaces	3.3.1.2.2 a.	I	I
Environmental characteristics of painted surfaces	3.3.1.2.2 b.	A	A
Paint finish	3.3.1.2.2 c.	I	I
Hazardous contents in paints	3.3.1.2.2 d.	A	A
Cadmium plating	3.3.1.2.3	N/A	N/A
Use of cadmium plating	3.3.1.2.3 a.	I	I
Cadmium on surfaces subject to frictional wear	3.3.1.2.3 b	I	I
Cadmium plating of bolts, nuts, etc	3.3.1.2.3 c.1.	I	I
Cadmium plating of limited tolerance items	3.3.1.2.3 c.2.	I	I
Cadmium plating of areas where controlled deposit cannot be obtained	3.3.1.2.3 c.3	I	I
Use of lubricants on cadmium plated parts	3.3.1.2.3 c.4	I	I
Electrical parts	3.3.1.3	N/A	N/A
Batteries	3.3.1.3.1	N/A	N/A
Two year battery life	3.3.1.3.1 a.1	A	A
Battery replacement in less than 30 min.	3.3.1.3.1 a.2.	D	D
OSHA safety	3.3.1.3.1 a.3	A,I	A,I
Battery backup time	3.3.1.3.1 a.4	A	A
Battery leakage	3.3.1.3.1 a.5.	D	D
Installation markings	3.3.1.3.1.1	I	I
Circuit breakers	3.3.1.3.2	N/A	N/A
Selection and application	3.3.1.3.2.1	N/A	N/A
Circuit breaker selection	3.3.1.3.2.1 a.	A	A
W-C-375 circuit breakers	3.3.1.3.2.1 b.	I	I
Trip free circuit breakers	3.3.1.3.2.1 c.	I	I
Circuit breakers compatibility with currents	3.3.1.3.2.1 d.	A,D	A,D
Manual operation of circuit breakers	3.3.1.3.2.1 e.	D	D
Circuit breaker use as switch	3.3.1.3.2.1 f.	I	I
Circuit breaker status indicator	3.3.1.3.2.1 g.	D,I	D,I
Electrical connectors - Environmental compatibility of connectors	3.3.1.3.3	A	A
Selection	3.3.1.3.3.1	N/A	N/A
Connector selection and use	3.3.1.3.3.1 a.	I	I
Consideration of intended use connector data in specification sheets	3.3.1.3.3.1 b.	A	A
Connector maintenance tools	3.3.1.3.3.1 c.	I	I
FAA tool list	3.3.1.3.3.1 d.	I	I
Connector MTTR < 1.5 hours	3.3.1.3.3.1 e.	D	D
Connectors with thermocouple contacts	3.3.1.3.3.2	N/A	N/A
Thermocouple connector identifiers	3.3.1.3.3.2 a. 1. & 2.	I	I
Thermocouple marker location	3.3.1.3.3.2 b.	I	I
Thermocouple material identifiers	3.3.1.3.3.2 c.	I	I
Power connectors	3.3.1.3.3.3	N/A	N/A
NEMA power connectors	3.3.1.3.3.3 a.	I	I
Polarized power connectors	3.3.1.3.3.3 b.	I,D	I,D

TABLE 6. REQUIREMENTS VERIFICATION MATRIX			
Protective measures	3.3.1.3.3.4	N/A	N/A
Dust caps on unmated connectors	3.3.1.3.3.4 a.	I	I
Moisture and vapor proof caps on live connectors	3.3.1.3.3.4 b.	I	I
Fuses, fuse holders, and associated hardware	3.3.1.3.4	N/A	N/A
Branch circuits open before main circuit	3.3.1.3.4.1 a.	D	D
Fuses as thermal overload devices	3.3.1.3.4.1 b.	A	A
Fuse rating compatible with currents encountered	3.3.1.3.4.1 c	D	D
Fuses replaceable within 5 min.	3.3.1.3.4.1 d	D	D
Extractor post type fuse holders	3.3.1.3.4.1 e.	I	I
Indicating meters	3.3.1.3.5	N/A	N/A
Panel meter per ANSI C39.1	3.3.1.3.5 a.	I	I
Meter accuracy	3.3.1.3.5 b.	T	T
Printed wiring board modifications	3.3.1.3.6	I	I
Conformal coating of PCB	3.3.1.3.7	I	I
When required	3.3.1.3.7 a.	I	I
MIL-I-46058 coating	3.3.1.3.7 b.	I	I
Electromagnetic shielding	3.3.1.3.8	N/A	N/A
Shield sensitive devices	3.3.1.3.8 a.	I	I
Effectiveness of EMI shielding	3.3.1.3.8 b.	T	T
Switches	3.3.1.3.9	D	D
Wiring	3.3.1.3.10	N/A	N/A
Clearance and leakage (creepage) distances	3.3.1.3.10.1	I	I
Marking/labeling	3.3.1.3.10.2	N/A	N/A
Signal, control and power wiring	3.3.1.3.10.2 a.	I	I
Marking at structural penetrations	3.3.1.3.10.2 b.	I	I
Wiring protection	3.3.1.3.10.3	N/A	N/A
Chafing protection	3.3.1.3.10.3 a.	I	I
Cable retractors near pull-out drawers	3.3.1.3.10.3 b	I	I
Cable clamps	3.3.1.3.10.3 c.	I	I
Insulation cold flow	3.3.1.3.10.4	I	I
Cable ducts	3.3.1.3.10.5	I	I
Bend radius	3.3.1.3.10.6	I	I
Sleeving	3.3.1.3.10.7	N/A	N/A
Type sleeving used	3.3.1.3.10.7 a.	I	I
Sleeving secured	3.3.1.3.10.7 b.	I	I
Cable anchored and formed	3.3.1.3.10.7 c.	I	I
Additional protection where abrasion not avoidable	3.3.1.3.10.7 d	I	I
Panel door cables	3.3.1.3.10.8	N/A	N/A
Minimum flexible wiring on hinged doors	3.3.1.3.10.8 a.	I	I
Cable arrangement for maintenance	3.3.1.3.10.8 b.	I	I
Through hole protection	3.3.1.3.10.9	N/A	N/A
Thin bulkhead (<1/8 in.)	3.3.1.3.10.9 a.	I	I
Thick bulkhead (>1/8 in.)	3.3.1.3.10.9 b.	I	I
Grommet for wires carrying RF above 500 VRMS	3.3.1.3.10.9 c.	I	I
Grommet exceptions in clearance areas	3.3.1.3.10.9 d.	I	I
Wiring arrangement	3.3.1.3.10.10	N/A	N/A
Wiring arranged for maintenance and access	3.3.1.3.10.10 a.	I	I
Placement of wire bundles	3.3.1.3.10.10 b.	I	I
Compatibility of lacing, etc. with cable jackets	3.3.1.3.10.10 c.	I	I
Wiring arranged for bundles or cable ducts	3.3.1.3.10.10 d.	I	I
Slack – short wires	3.3.1.3.10.11	I	I
Prevent undue cable stress	3.3.1.3.10.11 a.	I	I

TABLE 6. REQUIREMENTS VERIFICATION MATRIX			
Enable parts to be moved during maintenance	3.3.1.3.10.11 b.	I	I
Facilitate field repair of broken wiring	3.3.1.3.10.11 c.	I	I
Opening slide out drawers and racks	3.3.1.3.10.11 d.	D	D
Maintain bend radii when drawers and slides are fully open	3.3.1.3.10.11e	I	I
Bend radii for flat cable	3.3.1.3.10.11 f.	I	I
Ensure movement of cables and connections intended to move	3.3.1.3.10.11 g.	I	I
Wiring in terminal boxes	3.3.1.3.10.12	I	I
Entrance cable and wiring	3.3.1.3.10.13	I	I
Wire	3.3.1.3.10.14	I	I
Support	3.3.1.3.10.15	N/A	N/A
Cable and wire supported to avoid undo stress and motion	3.3.1.3.10.15 a.	I	I
Ensure separation of unprotected wiring	3.3.1.3.10.15 b.	I	I
No twine or tape	3.3.1.3.10.15 c.	I	I
Connectors, insulation sleeving	3.3.1.3.10.16	I	I
Fungus protection	3.3.1.3.10.17	N/A	N/A
In accordance with system level specification	3.3.1.3.10.17 a.	N/A	N/A
Cable-end fungus treatment	3.3.1.3.10.17 b.	I	I
Aluminum conductors	3.3.1.3.10.18	I	I
Termination of signal and control wiring	3.3.1.3.10.19	I	I
Fiber optics	3.3.1.3.10.20	I	I
Raised floor cabling	3.3.1.3.10.21.	I	I
Mechanical parts	3.3.1.4	N/A	N/A
Bearing Lubricant	3.3.1.4.1	N/A	N/A
Provide adequate lubricant	3.3.1.4.1 a.	I	I
Protection from old lubricant entering and impacting operation	3.3.1.4.1 b.	I	I
Compatibility of bearing preservative and lubricant	3.3.1.4.1 c.	I	I
Controls and switches	3.3.1.4.2	N/A	N/A
Direction of movement	3.3.1.4.2.1 a.	D	D
Response to movement	3.3.1.4.2.1 b.	D	D
Operating controls	3.3.1.4.2.2	I	I
Adjustment controls	3.3.1.4.2.3	N/A	N/A
Alignment and calibration control locations	3.3.1.4.2.3 a.	I	I
Use of common screwdriver adjustment	3.3.1.4.2.3 b.	I	I
Long term adjustment location	3.3.1.4.2.3 c.	I	I
Operation	3.3.1.4.2.4	N/A	N/A
Play and backlash in controls	3.3.1.4.2.4 a.	D	D
Operates freely and without binding	3.3.1.4.2.4 b.	D	D
Physical range of adjustment	3.3.1.4.2.4 c.	D	D
Stops	3.3.1.4.2.5	N/A	N/A
Mechanical stops	3.3.1.4.2.5 a.	D	D
Stops on flexible shafts	3.3.1.4.2.5 b.	I	I
Locking devices	3.3.1.4.2.6	N/A	N/A
Retain controls in any setting	3.3.1.4.2 6 a.	D	D
Ease of lock and unlock without affecting setting	3.3.1.4.2.6 b.	D	D
Control interaction in unlocked position	3.3.1.4.2.6 c.	D	D
Locks on vernier controls	3.3.1.4.2.6 d	D	D
Non-turn devices	3.3.1.4.2.7	I	I
Shafts and couplings	3.3.1.4.2.8	N/A	N/A
Adequate strength	3.3.1.4.2.8 a.	D	D
Shaft couplings	3.3.1.4.2.8 c.	I	I
Use of flexible couplings	3.3.1.4.2.8 d.	I	I

TABLE 6. REQUIREMENTS VERIFICATION MATRIX			
Couplings in frequency determining circuits	3.3.1.4.2.8 e.	I	I
Fastener hardware	3.3.1.4.3	N/A	N/A
General	3.3.1.4.3.1	N/A	N/A
Install & remove without damage	3.3.1.4.3 1 a.	D	D
Remain secure in normal operation	3.3.1.4.3.1 b.	D	D
More than one fastener	3.3.1.4.3.1 c.	I	I
Use of friction for connections	3.3.1.4.3.1 d	I	I
Special tools	3.3.1.4.4	N/A	N/A
Equipment life usability	3.3.1.4.4	A	A
Miscellaneous items	3.3.1.5	N/A	N/A
Glass	3.3.1.5.1	I	I
Electromagnetic compatibility	3.3.2	N/A	N/A
RF Emitters (transmitters)	3.3.2 a.	T	T
Equipment meets Part 2 and 15 of FCC regulations, Title 47	3.3.2 b.	T	T
EMI requirements	3.3.2 c.	T	T
Equipment meets Part 68 of FCC regulations	3.3.2 d.	T	T
Nameplates and marking	3.3.3	N/A	N/A
Nameplates	3.3.3.1	N/A	N/A
One or more nameplates required	3.3.3.1 a.	I	I
Nameplate in accordance with Fig 3	3.3.3.1 b	I	I
4-40 panhead screws to attach	3.3.3.1 c.	I	I
Equipment titles	3.3.3.1.1	N/A	N/A
Request for titles to CO	3.3.3.1.1 a.	N/A	N/A
Titles in equipment specifications not to be assumed to be correct	3.3.3.1.1 b.	N/A	N/A
Serial Numbers	3.3.3.1.2	N/A	N/A
Sequential from 1	3.3.3.1.2 a.	I	I
No duplicates for a part number	3.3.3.1.2 b.	I	I
Marking	3.3.3.2	N/A	N/A
Permanent and legible	3.3.3.2 a.	T,I	T,I
As specified in ANSI/IEEE-200	3.3.3.2 b.	I	I
Visibility of parts labels	3.3.3.2.1	I	I
Fuse positions	3.3.3.2.2	I	I
Terminal strips, blocks and wafer switches	3.3.3.2.3	I	I
Controls and indicating devices	3.3.3.2.4	N/A	N/A
All indicators, fuses and controls marked	3.3.3.2.4 a.	I	I
Correct relationship of markings to controls, fuses, indicators	3.3.3.2.4 b.	I	I
Interchangeability of parts	3.3.4	D	D
Personal safety and health	3.3.5	N/A	N/A
Safe clearances, workspaces, and other safety per NFPA-70, OSHA, and FAA Order 3900.19	3.3.5 a.	A,D,I,T	A,D,I,T
Seismic anchors	3.3.5 b.	A,T	A,T
Equipment design for personnel safety equal to or better than OSHA 1910	3.3.5 c.	I	I
Human engineering factors considered	3.3.5 d.	I	I
Equipment conforms to UL or other national standards	3.3.5 e.1	T	T
Personal protection when replacing filters	3.3.5 e.2.	D	D
Electrical safety	3.3.5.1	N/A	N/A
Personal protection from excess of 30 v in normal operation	3.3.5.1 a.	I	I
Dissipation of Power	3.3.5.1.a.1.	T	T
Protection of Circuits	3.3.5.1.a.2.	I	I

TABLE 6. REQUIREMENTS VERIFICATION MATRIX			
Physical protection for power input side of switches and connections	3.3.5.1 b.	I	I
Ground potential	3.3.5.1.1	N/A	N/A
Everything exposed except antennas and transmission line terminals are at ground potential	3.3.5.1.1 a.	T	T
External and interconnecting wire terminated at both ends	3.3.5.1.1 b.	I	I
Shields will not carry ground except for coax cable	3.3.5.1.1 c.	I	I
Antenna and transmission lines at ground potential except for RF	3.3.5.1.1 d	T	T
Plugs and convenience outlets provide ground to cable first and release ground last	3.3.5.1.1 e.	I	I
Casings of all components at ground potential except for semiconductor and microelectronics devices	3.3.5.1.1 f.	T	T
External casing encloses original case except for terminal sides	3.3.5.1.1 g.	I	I
Conductive chassis serves is common connection for safety and power ground	3.3.5.1.1 h.	I	I
Hinged or slide mounted panels and doors	3.3.5.1.2	N/A	N/A
Hinges shunted by ground strap	3.3.5.1.2 a.	I	I
System tie point to door or panel less that 0.1 ohm	3.3.5.1.2 b	T	T
Shielding	3.3.5.1.3	N/A	N/A
Shielding grounded on chassis or frame	3.3.5.1.3 a.	I	I
Sufficient distance from exposed conductors to ground	3.3.5.1.3 b.	I	I
Bonding in hazardous areas	3.3.5.1.4	I	I
Guarding of radio frequency voltages	3.3.5.1.5	I	I
Interlocks	3.3.5.1.6	N/A	N/A
None required if all potentials of 70 volts or more are totally protected	3.3.5.1.6 a.	I	I
Interlocks required when exposure to 70 volts or high is possible during maintenance or operation	3.3.5.1.6 b.	I	I
Bypassable interlock switches permit operation with doors open for maintenance	3.3.5.1.6.c	D,I	D,I
Bypassable interlocks allowable where voltages are not open to direct support personnel	3.3.5.1.6 d.	I,D	I,D
Proper location of bypass switches	3.3.5.1.6 e.	D	D
Non-bypassable interlocks for voltages over 500 volts	3.3.5.1.6 f.	I	I
Shorting rods	3.3.5.1.7	N/A	N/A
Provided when transmitting equipment voltages exceed 70 volts	3.3.5.1.7 a.	I	I
Stored within the equipment	3.3.5.1.7 b.	I	I
Meter safety	3.3.5.1.8	N/A	N/A
Provision for overload bypass in event of failure	3.3.5.1.8 a	I	I
1500 volt peak between terminals	3.3.5.1.8 b.	I	I
High voltage protection	3.3.5.1.9	N/A	N/A
Potentials above 500 volts enclosed and interlocked	3.3.5.1.9 a.	I	I
Holes for test probes	3.3.5.1.9 b.	I	I
High voltage measurement via test points at less than 300 volts	3.3.5.1.9 c.	T	T

TABLE 6. REQUIREMENTS VERIFICATION MATRIX			
Proper test point hardware for voltages above 30 volts	3.3.5.1.9 d.	I	I
Provide dual path from test point to ground	3.3.5.1.9 e.	I	I
Details of test point circuitry in manuals	3.3.5.1.9 f.	I	I
High current protection	3.3.5.1.10	I	I
Discharging devices	3.3.5.1.11	N/A	N/A
Provide discharge devices for capacitors and high voltage circuits	3.3.5.1.11 a.	I,T	I,T
Automatically activated when case is opened	3.3.5.1.11 b.	D	D
Shorting bars actuated by mechanical release or solenoid	3.3.5.1.11 c.	D	D
Bleeder resistor provides dual path to ground	3.3.5.1.11 d.	I	I
Devices will discharge circuits within 2 sec.	3.3.5.1.11 e.	T	T
Connectors, electrical	3.3.5.1.12	N/A	N/A
Operate protected on connector disconnect	3.3.5.1.12 a.	D	D
Pins on connectors will not be hot after disconnection	3.3.5.1.12 b.	D	D
Radio frequency (RF)/ microwave, X and laser radiation limits	3.3.5.2	N/A	N/A
Design to applicable standards	3.3.5.2a.	I,T	I,T
Laser radiation CFR title 21, chptr I subchptr J Part 1040)	3.3.5.2.3	I,T	I,T
Switches	3.3.5.3	N/A	N/A
Safety Switches	3.3.5.3	N/A	N/A
To deactivate mechanical drive units	3.3.5.3.1 a.	D	D
Override prevention on remotely located equipment	3.3.5.3.1 b.	D	D
Momentary override switches	3.3.5.3.2	D	D
Mechanical hazards	3.3.5.4	N/A	N/A
Low center of gravity	3.3.5.4 a.	D	D
Protection from moving fans, belts, etc	3.3.5.4 b.	D	D
Smooth corners on cabinets and doors with stops	3.3.5.4 c.	I	I
Prevent damage from pulling out doors or racks	3.3.5.4 d.	D	D
Power switches protected form accidental switching	3.3.5.4 e.	D	D
Mechanical interconnection	3.3.5.4.1	N/A	N/A
Means to prevent mismatching of mechanical parts	3.3.5.4.1 a.	I,D	I,D
Coding of mechanical parts where mismatches are possible	3.3.5.4.1 b.	I	I
Cathode ray tubes	3.3.5.4.2	I,T	I,T
Glass fibers	3.3.5.4.3	I	I
Markings, signs, tags, and symbols	3.3.5.5	N/A	N/A
Markings	3.3.5.5.1	N/A	N/A
Hazard marking on doors, guards, covers, etc	3.3.5.5.1 a.	I	I
Location of marking	3.3.5.5.1 b.	I	I
Internal markings	3.3.5.5.1 c	I	I
ANSI Z535.1 color codes	3.3.5.5.1 d.	I	I
Center of gravity marking	3.3.5.5.1 e.	I,T	I,T
Accident prevention signs and labels	3.3.5.5.2	N/A	N/A
When to use signs and labels	3.3.5.5.2 a.	I	I
Permanence of marking	3.3.5.5.2 b.	A	A
Sign Design	3.3.5.5.2.1	N/A	N/A
Three panels	3.3.5.5.2.1 a	I	I
Upper panel height to width ratio	3.3.5.5.2.1 a.1.	I	I

TABLE 6. REQUIREMENTS VERIFICATION MATRIX			
Lower panel width	3.3.5.5.2.1 a.2	I	I
Lower panel height	3.3.5.5.2.1 a.3	I	I
Optional symbol panel size	3.3.5.5.2.1 a 4	I	I
Content of upper panel	3.3.5.5.2.1 a.5.	I	I
Lower panel content	3.3.5.5.2.1 a.6.	I	I
Sign classifications and detailed design	3.3.5.5.2.2	N/A	N/A
Class 1 (danger)	3.3.5.5.2.2.1	N/A	N/A
When used	3.3.5.5.2.2.1 a.	I	I
Content of upper panel	3.3.5.5.2.2.1 b.	I	I
Content of lower panel	3.3.5.5.2.2.1 c	I	I
Class II (caution)	3.3.5.5.2.2.2	N/A	N/A
When to use	3.3.5.5.2.2.2 a.	I	I
Content of sign	3.3.5.5.2.2.2 b.	I	I
Class III (General safety)	3.3.5.5.2.2.3	N/A	N/A
When to use	3.3.5.5.2.2.3 a.	I	I
Content of upper panel	3.3.5.5.2.2.3 b.	I	I
Content of lower panel	3.3.5.5.2.2.3 c.	I	I
Class IV (Fire and emergency)	3.3.5.5.2.2.4	N/A	N/A
When to use	3.3.5.5.2.2.4 a.	I	I
Content of upper panel	3.3.5.5.2.2.4 b.	I	I
Content of lower panel	3.3.5.5.2.2.4 c.	I	I
Sign placement	3.3.5.5.2.3	N/A	N/A
Location	3.3.5.5.2.3 a.	D,I	D,I
Effects of sign	3.3.5.5.2.3 b.	I	I
MIL-STD-1472E	3.3.5.5.2.3 c.	I	I
Marking of radio active materials (OSHA requirements)	3.3.5.5.3	I	I
Symbols	3.3.5.5.4	N/A	N/A
Ionizing radiation hazard	3.3.5.5.4 a.	I	I
Microwave and RF radiation	3.3.5.5.4 b.	I	I
Laser	3.3.5.5.4 c.	I	I
Alerts/warnings	3.3.5.5.5	D	D
Audio Warning Signals	3.3.5.5.5.1	N/A	N/A
When to use	3.3.5.5.5.1 a.	A	A
Audio intensity	3.3.5.5.5.1 b.	T	T
Safety limits	3.3.5.5.5.1 c.	T	T
Display warnings	3.3.5.5.5.2	N/A	N/A
When used	3.3.5.5.5.2 a.	A	A
Clearly discriminative features	3.3.5.5.5.2 b.	D,I	D,I
Battery warning label	3.3.5.5.5.3	I	I
Hazardous and restrictive materials	3.3.5.6	N/A	N/A
Assessment of potential	3.3.5.6 a.	A	A
Assessment activities	3.3.5.6 b.	A	A
Carcinogens	3.3.5.6.1	A,I	A,I
Dusts, mists, fumes, and gases	3.3.5.6.2	N/A	N/A
Emissions dangerous to humans	3.3.5.6.2 a.	T	T
Emissions dangerous to plant, etc	3.3.5.6.2 b.	T	T
Emission of flammable gases	3.3.5.6.2 c.	T	T
Restricted materials	3.3.5.6.3	I	I
Human engineering	3.3.6	A,I	A,I
Noise criteria requirement	3.3.6.1	N/A	N/A
Outside areas	3.3.6.1 a.	T	T
In operational areas	3.3.6.1 b	T	T
In equipment areas	3.3.6.1 c	T	T
In special areas/offices	3.3.6.1 d	T	T

TABLE 6. REQUIREMENTS VERIFICATION MATRIX			
In high noise/remote areas	3.3.6.1 e	T	T
Identification of noise hazard areas	3.3.6.1.1	N/A	N/A
When warning signs are needed	3.3.6.1.1 a.	T,I	T,I
Visibility of signs	3.3.6.1.1 b	I	I
Manuals address noise hazards	3.3.6.1.1 c.	I	I
Ergonomic considerations	3.3.6.2	I	I
Weight lifting limits	3.3.6.3	N/A	N/A
Apply to male and female	3.3.6.3 a.	N/A	N/A
Limits	3.3.6.3 b.	T	T
Multiple weight lifts	3.3.6.3 c	T	T
Visual displays	3.3.6.4	N/A	N/A
Lighting levels	3.3.6.4 a.	T	T
Display illumination and light distribution	3.3.6.4.1	N/A	N/A
Commensurate with operational uses	3.3.6.4.1 a.	D	D
Factors to be considered	3.3.6.4.1 b.	D	D
Consistent across displays	3.3.6.4.1 c.	D	D
Use of numeric displays	3.3.6.4.1 d.	D	D
Display information	3.3.6.4.2	N/A	N/A
Data on status change	3.3.6.4.2 a.	D	D
Selectable data, minimum amount	3.3.6.4.2 b.	A,D	A,D
Display positive feedback	3.3.6.4.3	N/A	N/A
Equipment status displayed	3.3.6.4.3 a.	D	D
Requires positive responses	3.3.6.4.3 b.	D	D
Light-emitting diodes (LED) Displays	3.3.6.4.4	N/A	N/A
May be used	3.3.6.4.4 a.	A	A
Colors to be used	3.3.6.4.4 b.	D	D
Flash	3.3.6.4.5	N/A	N/A
When to use	3.3.6.4.5 a.	A,D	A,D
Flash rate	3.3.6.4.5 b.	T	T
Synchronization of multiple indicators	3.3.6.4.5 c	D	D
Labeling	3.3.6.5	N/A	N/A
When to use	3.3.6.5 a.	A	A
Label orientation	3.3.6.5 b.	I	I
Label content	3.3.6.5 c.	I	I
MIL-STD-1472E requirements	3.3.6.5 d.	I	I

4.2.2 Classification of Tests.

Four classes of tests are required, as follows, unless otherwise specified by the contract:

a. Design Qualification Tests (Paragraph 4.2.1.1)

b. Type Tests (Paragraph 4.2.1.2)

c. Production Tests (Paragraph 4.2.1.3)

d. FCC Type Acceptance and Registration Procedures (Paragraph 4.2.1.4)

4.2.2.1 Design Qualification Tests.

The following tests shall be performed on regular production equipment selected by the Government Representative.

a. Rating verification, parts and materials (Paragraph 4.2.1.1.1)

b. General specification tests (Paragraph 4.2.1.1.2)

c. Design qualification tests as required by the equipment specification

4.2.2.1.1 Rating Verification of Parts and Materials.

Measurements and/or calculations shall be made in order to establish that the parts and insulating materials used in the equipment will not be subjected to voltages, currents, power dissipation, and temperature, in excess of the derated values permitted by applicable specification requirements and this specification.

All power supplies over 600 volts which are potted or encapsulated shall be subjected to a 48 hour heat run with all critical internal components instrumented to insure that proper temperature derating has been incorporated in the design.

The instrumented heat run shall be performed with the power supply operating in the equipment in its final configuration location.

4.2.2.1.2 General Specification Tests.

Tests shall be performed once on regular production equipment.

4.2.2.2 Type Tests.

Tests shall be performed on regular production equipment or systems in accordance with the requirements herein.

4.2.2.2.1 Type Test Equipment Selection.

The equipment selection for type testing shall be in accordance with the contract schedule and/or the equipment specification.

In the absence of specific contract schedule or the equipment specification, the following subparagraphs apply:

4.2.2.2.1.1 Identification.

The equipment on the contract shall be assigned sequential numbers in order as they reach the stage of completion and readiness for testing. Using these sequential numbers, the equipment shall be divided into groups for type testing as shown in Table 7.

One type test shall be performed for each type test group.

With the exception of Type Test No. 1, selection of an equipment for type test within the group shall be made by the FAA Quality representative.

TABLE 7. TYPE TEST EQUIPMENT SELECTION

Contract Qnty	TYPE -TEST GROUPS							
	I	II	III	IV	V	VI	VII	VIII
1-10	1							
11-25	1	2-10						
26-50	1	2-10	11-35					
51-75	1	2-10	11-35	36-60				
76-100	1	2-10	11-35	36-75				
101-150	1	2-10	11-50	51-100				
151-200	1	2-10	11-50	51-100	101-150			
201-300	1	2-10	11-50	51-100	101-150	151-200		
301-500	1	2-10	11-50	51-100	101-200	201-300	301-400	
501-700	1	2-10	11-50	51-100	101-200	201-300	301-400	401-600
701 & up	As specified in the procurement document.							

4.2.2.3 Production Tests.

Production tests shall be performed in accordance with the Government approved test procedures on each production equipment.

4.2.2.4 FCC Type Acceptance and Registration Procedures.

Where applicable, the first production equipment delivered to the government shall be subjected to the FCC type acceptance and registration procedures in accordance with FCC Rules and Regulations: Title 47, Part 2, and Part 68.

The environmental temperature range specified by the FCC shall supersede, for the purposes of the FCC Type Acceptance Procedures, the service conditions temperature range which is applicable under this specification.

4.2.2.5 Fail-safe Demonstration Test.

A fail-safe demonstration test shall be performed on a production article.

4.2.2.6 RMS Fail-soft Demonstration Test.

An RMS fail-soft demonstration test shall be performed on a production article.

4.2.2.7 Maintainability Demonstration Tests.

Maintainability demonstration tests shall be conducted as required in the contract.

Maintainability demonstration tests shall be performed on regular production equipment.

4.2.3 Normal Testing Conditions.

Except for operating range testing, the equipment shall be tested under the normal operating range specified in Section 3.

4.2.3.1 Wind and Ice Loading Testing.

Where wind and ice loading are specified under the service conditions, the contractor has the option of demonstrating compliance by any of the following means; dynamic testing, static load testing using loads which produce stresses equivalent to the specified dynamic loads, or calculations of structural strength versus dynamic stresses based on design parameters and parts and materials specifications.

4.2.3.2 Environmental (service conditions) Testing.

Design qualification tests and type tests performed to verify environmental testing shall be under the following conditions without equipment adjustment, and shall be conducted with the equipment in a thermally-insulated chamber.

a. Place equipment in chamber under ambient conditions. Make all required tests and record all readings.

b. Uniform ambient temperature throughout the chamber shall be obtained.

c. Means of slowly circulating the air in the chamber may be provided, but violent agitation of the air resulting in rapid circulation through and around the equipment will not be permitted.

d. The chamber shall be equipped with recording devices that will read on detachable material a continuous record of both temperature and humidity.

e. When making the required tests, line voltage and frequency variation shall be included.

f. Tests shall be performed with the equipment on and shall be in accordance with the following procedure:

1. No further adjustments to controls of equipment under test shall be made during Steps 2 through 9.

2. Reduce temperature to minimum specified in Section 3.2.1.1.1.1 at any relative humidity. Maintain minimum temperature for not less than 6 hours.

3. Begin the test at least 15 minutes after the equipment under test has stabilized at a minimum temperatureas determined by sensors located in the equipment. Finish all tests as rapidly as possible and record readings.

4. Increase temperature to maximum specified in Section 3.2.1.1.1.1 for service conditions in 5 hours or less at any relative humidity. Maintain maximum temperaturefor not less than 6 hours. During this process, record all readings at approximately each 100^{o}C rise in temperature, but not less than once an hour during the temperature increasing period. During stabilization period, record all readings once an hour with a final reading at end of the period.

5. Adjust relative humidity to high humidity range, holding temperature to maximum specified. Maintain chamber at these values of ambient temperature and relative humidity for not less than 24 hours.

6. Begin tests. Finish all tests as rapidly as possible and record all readings.

7. Return chamber to ambient conditions. Equipment may now be removed from chamber.

8. After temperature and relative humidity stabilize, allow the equipment to operate for not less than 48 hours under ambient conditions. Record all readings at beginning and end of the 48-hour period.

9. After the complete cycle of tests the equipment shall be examined for indications of rust, corrosion, flaking of plating, deterioration of paint, and deformation of plastic materials, to determine specification compliance.

4.2.4 Test Equipment.

4.2.4.1 Basic Instrument Accuracy.

Instrument accuracy shall be a minimum of 10 times more accurate than the reading required accuracy.

When using analog meters, all readings shall be made within the upper 50 percent of the scale arc.

5 PREPARATION FOR DELIVERY

5.1 General.

Requirements for packaging, packing and marking for shipment shall be as specified in the equipment specification or work statement and will be in accordance with MIL-STD-2073/1C, DOD Material Procedure for Development and Application of Packaging Requirements; MIL-STD-129, Marking for Shipment and Storage; and ASTM-D-3951, Standard Practices for Commercial Packaging.

Equipment shipped, stored or transferred in geographic areas which will be exposed to non-operating conditions beyond the temperatures stated in section 3.2.1.2.4 shall be packaged to withstand the environmental condition of the geographic area.

6.0 NOTES

6.1 General . Appendix I provides guidance for tailoring the requirements for a Developmental, NDI or COTS procurement. This specification contains a set of requirements designed to be tailored for each contract by the government program office. The tailoring process for this specification is the deletion of non-applicable requirements.

6.2 Acronyms and Abbreviations. The following list contains all approved contractions and acronyms used by the NAS for the purpose of the specification.

AGMA	American Gear Manufactures Association
ANSI	American National Standards Institute
ASTM	American Society for Testing Materials
AWS	American Welding Society Inc.
AC	Alternating Current
BAFO	Best and Final Offer
BIT	Built-in-Test
C	Celsius
CASE	Computer Aided Software Engineering
CFR	Code of Federal Regulations
COTS	Commercial Off the Shelf
CRT	Cathode Ray Tube
DESC	Defense Electronics Supply Center
DISC	Defense Industrial Supply Center
dB	decibel
DC	Direct Current
ECSA	Exchange Carriers Standards Association
EL	Electroluminescent
EMI	Electromagnetic Interface
ER	Established Reliability
FAA	Federal Aviation Administration
FCC	Federal Communications Commission
FPM	Feet pa Minute
FRACAS	Failure Reporting, Analysis, and Corrective Action System
Hz	Hertz
ILS	Instrument Landing System
ILSP	Integrated Logistics Support Plan
I	Current
IN	Individual Current Harmonic Distortion
VO	input/output
LCD	Liquid Crystal Display
LED	Light-emitting Diode
LRU	Line Replaceable Unit
m	meters
ma	milliamps
mm	millimeters
MEP	Mobile Electrical Power
MPCAG	Military Parts Control Advisory Groups
MTBF	Mean Time Between Failure
MTTR	Mean Time To Repair
NAS	National Airspace System
NFPA	National Fire Protection Association
NPAR	Nonstandard Part Approval Request
NDI	Non-Developmental Items
NTIA	National Telecommunications and Information Administration

OSHA	Occupational Safety and Health Act
PF	Power Factor
PPSL	Program Part Selection List
QRO	Quality Review Officer
RF	Radio Frequency
RFP	Request for Proposal
RFB	Request for Bid
RMM	Remote Maintenance Monitoring
RMS	Remote Monitoring Subsystem
SMD	Standard Military Drawing
SPC	Statistical Process Control
THDs	Maximum Total Current Harmonic Distortion
TR	Technical Report
UL	Underwriters Laboratories, Inc.
UPS	Uninterruptible Power Sets
V	Volts
VA	Volt Ampere
VSWR	Voltage Standing Wave Ratio
W	Watt
WS	Water Soluble

APPENDIX I

10.0 ITI (CBEMA) Curve

SCOPE:

The ITI (CBEMA) Curve and this Application Note describe an AC input voltage boundary which typically can be tolerated (no interruption of function) by most Information Technology Equipment (ITE). The Curve and this Application Note comprise a single document and are not to be considered separately from each other. They are not intended to serve as a design specification for products or AC distribution systems. The Curve and this Application Note describe both steady-state and transitory conditions.

APPLICABILITY:

The Curve and this Application Note are applicable to 120V nominal voltages obtained from 120V, 208Y/120V, and 120/240V 60 Hz systems. Other nominal voltages and frequencies are not specifically considered and it is the responsibility of the user to determine the applicability of these documents for such conditions.

DISCUSSION:

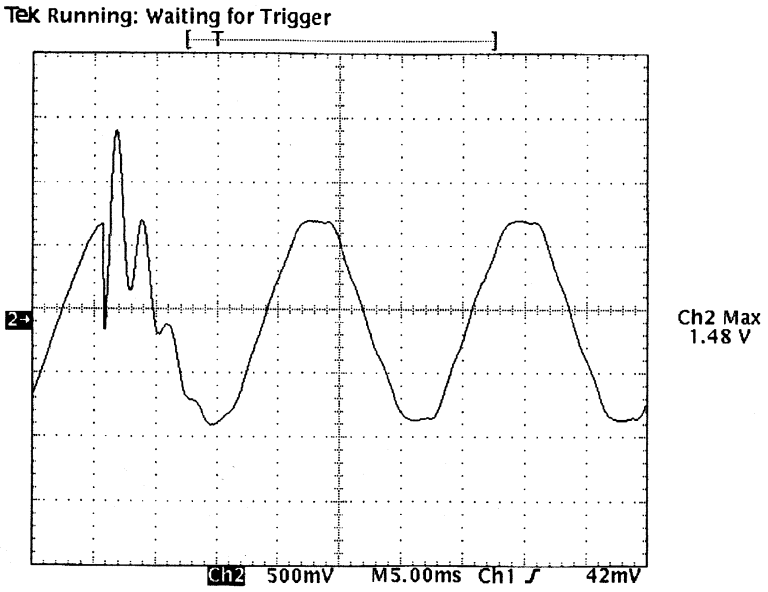
This section provides a brief description of the individual conditions which are considered in the Curve. For all conditions, the term "nominal voltage" implies an ideal condition of 120V RMS, 60 Hz.
Seven types of events are described in this composite boundary. Each event is briefly described in the following sections, with two similar line voltage sags being described under a single heading. Two conditions outside the boundary are also noted. All conditions are assumed to be mutually exclusive at any point in time and, with the exception of steady-state tolerances, are assumed to commence from nominal voltage.

Steady-State Tolerances:
The steady-state range describes an RMS voltage which is either very slowly varying or is constant. The subject range is ±10% from the nominal voltage. Any voltages in this range may be present for an indefinite period, and are a function of normal loading and losses in the distribution system.

Line Voltage Swell:
This region describes a voltage swell having an RMS amplitude of up to 120% of the RMS nominal voltage with a duration of up to 0.5 seconds. This transient may occur when large loads are removed from the system or when a voltage is supplied from sources other than the electrical utility.

Low-Frequency Decaying ringwave:
This region describes a decaying ringwave transient which typically results from the connection of power factor correction capacitors to an AC distribution system. The frequency of this transient may range from 200 Hz to5 KHz, depending upon the resonant frequency of the AC distribution system. The magnitude of the transient is expressed as a percentage of the *peak* 60 Hz nominal voltage (not RMS value). The transient is assumed to be completely decayed by the end of the half-cycle in which it occurs. The transient is assumed to occur near the peak of the nominal voltage waveform. The amplitude of the transient varies from 140% for 200 Hz ringwaves to 200% for 5 KHz ringwaves, with linear increase in amplitude with increasing frequency. Refer to Figure 1 for a typical waveform.

FIGURE 1



TYPICAL LOW FREQUENCY DECAYING RINGWAVE

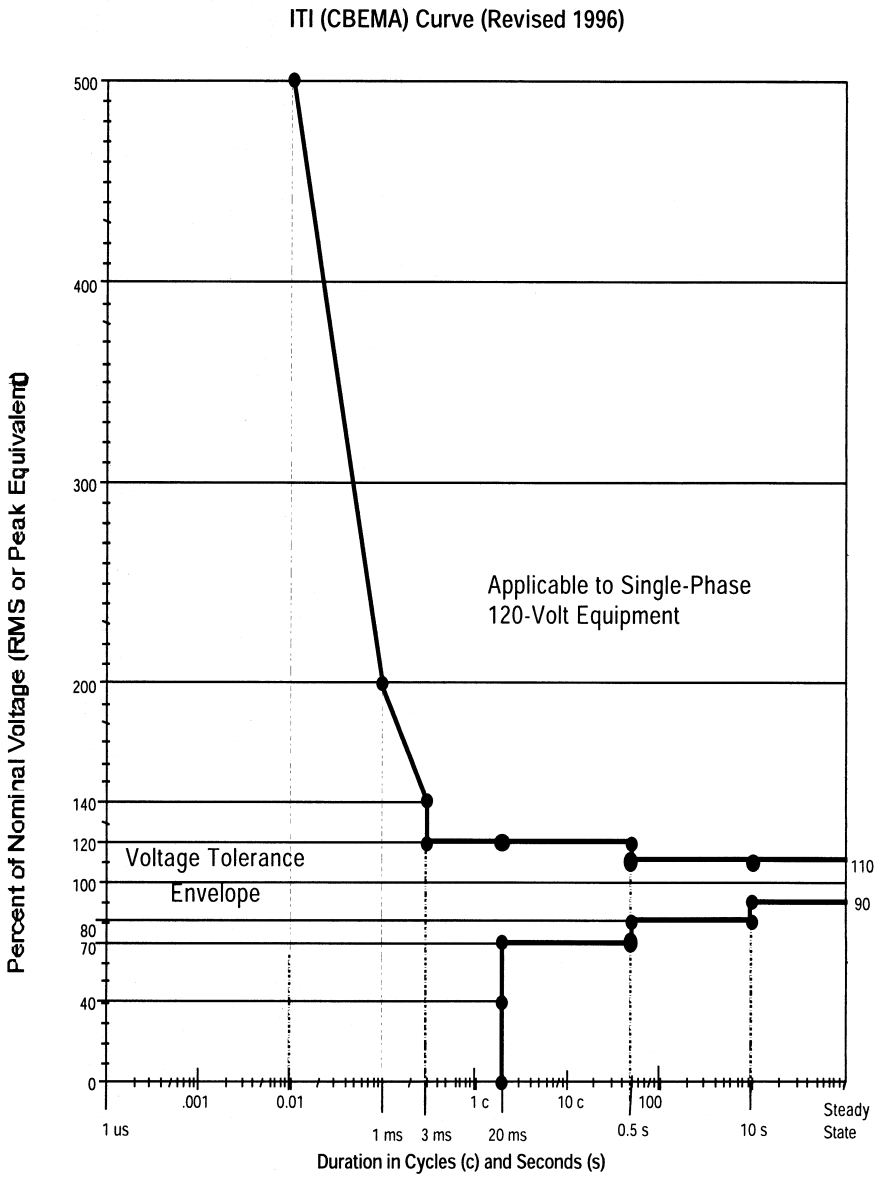
High-Frequency Impulse and Ringwave:
This region describes the region the transients which typically occur as a result of lightning strikes. Wave shapes applicable to this transient and general test conditions are described in ANSI/IEEE62.41-1991. This region of the curve deals with both amplitude and duration (energy), rather than RMS amplitude. The intent is to provide an 80 Joule minimum transient immunity.

Voltage Sags:
Two different RMS voltage sags are described. Generally, these transients result from the application of heavy loads, as well as fault conditions, at various points in the AC distribution system. Sags to 80 % of the nominal (maximum deviation of 20%) are assumed to have a typical duration of up to 10 seconds, and sags to 70% of nominal (Maximum deviation of 30%) are assumed to have a typical duration of up to 5 seconds.

Dropout:
A voltage dropout includes both severe RMS voltage sags and complete interruptions of applied voltage, followed by immediate re-application of the nominal voltage. The interruption may last up to 20 Milliseconds. This transient typically results from the occurrence and subsequent clearing of faults in the distribution system.

No-Damage Region:
Events in this region include sags and dropouts which are more severe than those specified in the preceding paragraphs, and continuously applied voltages which are less than the lower limit of the steady state tolerance range. The normal functional state of the ITE is not typically expected during these conditions, but no damage to the ITE should result.

Prohibited Region:
This region includes any surge or swell which exceeds the upper limit of the boundary. If ITE is subjected to such conditions, damage to the ITE may result.



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APPENDIX II

20.0 GOVERNMENT DOCUMENTS

The following documents of the issue in effect on the date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this specification, the contents of this specification shall be considered a superseding requirement.

SPECIFICATIONS:

Federal

QQ-S-365	Silver Plating, Electrodeposited: General Requirements for
W-C-375	Circuit Breakers, Molded Case; Branch Circuit and Service
QQ-P-416	Plating, Cadmium (Electrodeposited)
L-P-516	Plastic Sheet and Plastic Rod, Thermosetting, Cast
J-C-580	Cord, Electrical and Wire, Electrical (0 to 600 Volt Service)
W-C-596	Connector, Electrical Power, General Specification for
W-C-596/12	Connector, Receptacle. Electrical, General Purpose, Duplex, Hospital Grade Grounding, 2 Pole, 3 wire, 1S Amperes, 12S Volts, S0/60 Hertz
W-C-596/13	Connector, Plug, Electrical, General Purpose, Hospital Grade Grounding, 2 Pole, 3 Wire, 1S Amperes, 12S Volts, S0/60 Hertz
A-A-1419	Filter Element, Air Conditioning (Viscous Impingement and Dry Types, Replaceable)
TT-S-1732	Sealing Compound; Pipe Joint and Thread, Lead Free General Purpose
ZZ-R-765	Rubber, Silicone (General Specification)

Federal Aviation Administration

FAA-C-1217	Electrical Work, Interior
FAA-D-2494	Technical Instruction Book Manuscript: Electronic, Electrical, and Mechanical Equipment, Requirements for Preparation of Manuscript and Production of Books

Military

MIL-I-10	Insulating Compound, Electrical, Ceramic Class L

MIL-M-14	Molding Compounds, Thermosetting
MIL-T-27	Transformers and Inductors (Audio, Power, and High Power Pulse), General Specification for
MIL-S-61	Shunts, Instrument, External, 50 Millivolt (Lightweight Type)
MIL-T-1S2	Treatment, Moisture and Fungus-Resistant of Communications.Electronic and Associated Electrical Equipment
MIL-V-173	Varnish, Moisture and Fungus Resistant (for Treatment of Communications, Electronic, and Associated Equipment)
MIL-J-641	Jacks, Telephone, General Specification for
MIL-P-642	Plugs, Telephone, and Accessory Screws. General Specification for
MIL-G-1149	Gasket Materials, Synthetic Rubber,50 and 65 Durometer Hardness
MIL-1-1361	Instrument Auxiliaries, Electrical Measuring; Shunts, Resistors, and Transformers
MIL-S-3644	Shaft Assembly, Flexible
MIL-L-3661	Lampholders, Indicator Lights. Indicator-Light Housings, and Indicator-Light Lenses, General Specification for
MIL-G-3787	Glass. Laminated, Flat; (Except Aircraft)
MIL-S-5002	Surface Treatments and Inorganic Coatings for Metal Surfaces of Weapons Systems
MIL-C-5541	Chemical Conversion Coatings on Aluminum and Aluminum Alloys
MIL-W-6858	Welding, Resistance: Spot and Seam
MIL-S-7742	Screw Threads, Standard, Optimum Selected Series: General Specification for
MIL-B-007883	Brazing of Steels, Copper, Copper Alloys Nickel Alloys, Aluminum and Aluminum Alloys
MIL-T-7928	Terminals, Lug: Splices, Conductors: Crimp Style, Copper, General Specification for
MIL-S-8805/56	Switch Assemblies, Sensitive, Interlock, Unsealed
MIL-S-8879	Screw Threads, Controlled Radius Root with Increased Minor Diameter, General Specification for
MIL-W-8939	Welding, Resistance, Electronic Circuit Modules

MIL-C-10544	Connectors, Plug and Receptacle (E:lectrical, Audio, Waterproof, Ten Contact, Polarized)
MIL-T-10727	Tin Plating; Electrodeposited or Hot-dipped, for Ferrous and Nonferrous Metals
MIL-S-12285	Switches. Thermostatic
MIL-C-12S20	Connectors, Plug and Receptacle (Electrical, Waterproof), and Accessories, General Specification for
MIL-S-12883	Sockets and Accessories for Plug-In Electronic Components Genaal Specification for
MIL-P-15024	Plates, Tags and Bands for Identification of Equipment
MIL-C-lS30S	Coils, Fixed and Variable, Radio Frequency, General Specification for
MIL-F-15733	Filters and Capacitors Radio Frequency Interference, General Specification for
MIL-S-15743	Switches, Rotary, Enclosed
MIL-F-16552	Filters, Air Environmental Control System, Cleanable. Impingement (High Velocity Type)
MIL-F-18327	Filters; High Pass, Low Pass, Band Pass, Band Suppression and Dual Functioning, General Specification for
MIL-S-18396	Switches, Meter and Control, Naval Shipboard
MIL-S-19500	Semiconductor Devices, General Specification for
MIL-C-19978	Capacitors, Fixed, Plastic (or Paper-Plastic) Dielectric. (Hermetically Sealed in Metal, Ceramic, or Glass Cases), Established and Non-established Reliability, General Specification for
MIL-T-21038	Transformers, Pulse, Low Power, General Specification for
MIL-S-21604	Switches, Rotary, Multipole and Selector, General Specification for
MIL-T-22361	Thread Compound; Antiseize, Zinc Dust-Pevolatum
MIL-S-22432	Servomotors, General Specification for
MIL-S-22473	Sealing, Locking and Retaining Compounds: (Single-Component)

MIL-S-22820	Servomotor-Tachometer Generator AC; General Specification for
MIL-T-22821	Tachometer Generator AC; General Specification for
MIL-B-23071	Blower, Miniature, for Cooling Electronic Equipment, General Specification for
MIL-I-23264	Insulators, Ceramic. Electrical and Electronic, General Specification for
MIL-T-23648	Thermistor (Thermally Sensitive Resistor), Insulated; Gensal Specification for
MIL-I-24092	Insulating Varnishes and Solventless Resins for Application by the Dip Process
MIL-I-24768	Insulation, Plastics. l Aminatedb Thermosetting; General Specification for
MIL-P-25518	Plastic Materials, Silicone Resin, Glass Fiber Base, Low Pressure Laminated
MIL-D-28728	Dial, Control, Multi-turn Countas General Specification for
MIL-R-287S0	Relay, Solid State, General Specification for
MIL-C-28803	Display, Optoelectronic, Readouts, Backlighted, Segmented, General Specification for
MIL-D-28809	Circuit Card Assemblies, Rigid, Flexible, and Rigid-Flex
MIL-T-31000	Technical Data Packages, Genaal Specification for
MIL-M-38510	Microcircuits, General Specification for
MIL-M-38527	Mounting Pads, Electrical-Electronic Component, General Specification for
MIL-1-38535	Integrated Circuits (Microcircuits) Manufacturing, General Specification for
MIL-C-39003	Capacitors. Fixed, Electrolytic (Solid Electrolyte), Tantalum, Established Reliability, General Specification for
MIL-C-39006	Capacitors, Fixed, Electrolytic (Nonsolid Electrolyte). Tantalum, Established Reliability, General Specification for
MIL-C-39006/22	Capacitors, Fixed, Electrolytic (Nonsolid Electrolyte), Tantalum, (Polarized,Sintered Slug), 85 DEG C (Voltage Derated to 125 DEG C), Established Reliability, Style CLR79
MIL-C-39006/25	Capacitors, Fixed, Electrolytic (Nonsolid Electrolyte), Tantalum (Polarized, Sintered Slug) (Extended Range),85 DEG C (Voltage Derated to 125 DEG C), Established Reliability, Style CLR81

MIL-C-39010	Coils, Electrical, Fixed Radio Frequency, Molded. EstaWshed Reliability, General Specification for
MIL-C-39018	Capacitors, Fixed, Electrolytic (Aluminum Oxide), Established Reliability and Nonestablished Reliability General Specification for
MIL-I-46058	Insulating Compound, Electrical (for Coating Printed Circuit Assemblies)
MIL-P-46112	Plastic Sheet and Strip, Polyimide
MIL-W-46132	Welding, Fusion, Electron Beam. Process for (use AMS 2680, AMS 2681)
MIL-S-46163	Sealing. Lubricating, and Wicking Compounds: Thread-Locking, Anaerobic. Single Component
MIL-R-50781	Resolvers, Electrical, Linear, General Specification for
MIL-C-55116	Connectors; Miniature Audio, Five-Pin and Six-Pin, General Specification for
MIL-T-55164	Terminal Boards, Molded, Barrier, Screw and Stud Types, and Associated Accessories, General Specification for
MIL-C-55181	Connectors, Plug and Receptacle, Intermediate Power (Electrical, Waterproof), Type MW, General Specification for
MIL-0-55310	Oscillators, Crystal, General Specification for
MIL-A-55339	Adapters, Connector, Coaxial, Radio Frequency, (Between Series and Within Series), General Specification for
MIL-R-55342	Resistors. Fixed, Film, Chip, Established Reliability, General Specification for
MIL-C-55514	Capacitors, Fixed, Plastic (or Metalized Plastic) Dielectric DC or DC-AC, in Nonmetal Cases, Established Reliability, General Specification for
MIL-T-55631	Transformers; Intermediate Frequency, Radio Frequency and Discriminator, General Specification for
MIL-E-81512	Encoder, Shaft Position to Digital, Contact Type, Altitude Reporting; General Specification for
MIL-B-81744	Barrier Coating solution, Lubricant Migration Deterring
MIL-S-81963	Servocomponent, Precision Instrument, Rotating, Common Requirements and Tests, General Specification for
MIL-I-83446	Coils, Radio Frequency, Chip, Fixed or Variable, General Specification for

MIL-C-83503	Connectors. Electrical, Flat Cable and/or Printed Wiring Boards, Non-environmental, General Specification for
MIL-D-83531	Delay Lines, Passive, General Specification for
MIL-T-83721	Transformers, Variable, Power, General Specification for
MIL-T-83727	Transolvers, General Specification for
MIL-S-83731	Switches, Toggle, Unsealed and Sealed Toggle, General Specification for
MIL-S-83734	Sockets, Plug-in Electronic Components, Dual-in-Line (DIPS) and Single-in-Line Packages (SIPS) General Specification for
MIL-E-85082	Encoders, Shaft Angle to Digital, General Specification for
MIL-D-87157	Displays, Diode, Light Emitting, Solid State, General Specification for

STANDARDS:

Federal

FED-STD-H28	Screw-Thread Standards for Federal Services Federal Aviation Administration
FAA-STD-013	Quality Control Program Requirements
FAA-STD-016	Quality Control System Requirements
FAA-STD-020	Transient Protection, Grounding, Bonding and Shielding Requirements for Equipment
FAA-STD-021	Configuration Management
FAA-STD-028	Contracts Training Programs
FAA-STD-032	Standards for National Airspace System Physical Facilities
FAA-STD-049	Fiber Optics for Communications Equipment and Systems

Military

MIL-STD-12	Abbreviations for Use on Drawings. and in Specifications, Standards and Technical Documents
MIL-STD-22	Welded Joint Design
MIL-STD-100	Engineering Drawing Practices
MIL-STD-129	Marking for Shipment and Storage
MIL-STD-248	Welding and Brazing Procedure and Performance Qualification

MIL-STD-276	Impregnation of Porous Nonferrous Metal Castings
MIL-STD-280	Definitions of Item Levels, Item Exchangeability, Models, and Related Terms
MIL-STD-415	Test Provisions for Electronic Systems and Associated Equipment, Design Criteria for
MIL-STD-454	Requirement 9—Standard General Requirements for Electronic Equipment: Workmanship
MIL-STD-454	Requirement 76—Standard General Requirements for Electronic Equipment: Fiber Optics
MIL-STD 461	Electromagnetic Emission and Susceptibility Requirements for the Control of Electro-magnetic Interference
MIL-STD 470	Maintainability Program for Systems and Equipment
MIL-STD-471	Maintainability Verification/Demonstration/Evaluation
MIL-STD-681	Identification Coding and Application of Hook-up and Lead Wire
MIL-STD-683	Crystal Units (Quarlz), Crystal Holders (Enclosures) and Oscillators, Selection of
MIL-STD-701	Lists of Standard Semiconductor Devices
MIL-STD-710	Synchros. 60 and 400 Hertz, Selection and Application of
MIL-STD-756	Reliability Modeling and Pedictions
MIL-STD-750	Test Methods for Semiconductor Devices
MIL-STD-785	Reliability Program for Systems and Equipment Development and Production
MIL-STD-883	Microelectronics, Test Methods and Procedures for
MIL-STD-889	Dissimilar Metals
MIL-STD-965	Parts Control Prograrn
MIL-STD-1130	Connections, Electrical, Solderless, Wrapped
MIL-STD-1132	Switches and Associated Hardware, Selection and Use of
MIL-STD-1261	Arc Welding Procedures for Constructional Steel
MIL-STD-1277	Splices, Terminals, Terminal Boards, Binding Posts, Terminal Junction

	Systems, Wire Caps; Electrical
MIL-STD-1279	Meters, Electrical Indicating, Selection and Use of
MIL-STD-1285	Marking of Electrical and Electronic Parts
MIL-STD-1286	Transformers, Inductors, and Coils, Selection and Use of
MIL-STD-1334	Process for Barrier Coating of Anti-friction Bearings
MIL-STD-1346	Relays, Selection and Application
MIL-STD-1353	Electrical Connectors, Plug in Sockets and Associated Hardware, Selecion and Use of
MIL-STD-1360	Fuses, Fuseholders, and Associated Hardware, Selection and Use of
MIL-STD-1388-1	Logistic Support Analysis
MIL-STD-1395	Filters and Networks, Selection and Use of
MIL-STD-1451	Resolvers, Electrical, Selection of
MIL-STD-1472	Human Engineering Design Criteria for Military Systems, Equipment, and Facilities
MIL-STD-1474	Noise Limits for Military Materiel (Metric)
MIL-STD-1498	Circuit Breakers, Selection and Use of
MIL-STD-1516	Unified Code for Coatings and Finishes for DOD Material
MIL-STD-1547	Electronic Parts, Materials, and Processes for Space and Launch Vehicles
MIL-STD-1S62	Lists of Standard Microcircuits
MIL-STD-lS95	Qualification of Aircraft, Missile and Aerospace Fusion Welders
MIL-STD-1646	Servicing Tools for Electric Contacts and Connections, Selection and Use of
MIL-STD-1686	Electrostatic Discharge Control Program for Protection of Electrical and Electronic Pans, Assemblies and Equipment (Excluding Electrical Initiated Explosive Devices)
MIL-STD-2073	DOD Material Procedures for Development Application of Packaging Requirements
MIL-STD-2175	Castings, Classification and Inspection of
MIL-STD-2219	Fusion Welding for Aerospace Applications

MS33540 Safety Wiring and Cotter Pinning, General Practices for

DRAWINGS:

DESC (Defense Electronics Supply Center)

87203 Connector, Plug, E:lectrical, Midget Locking, Specific Purpose, General Grade, Grounding, 2 Pole,3 Wire,15 Amperes,12S Volts, S0/60 Hertz (Male)

87204 Connector, Plug, Electrical, Midget Locking, Specific Purpose. General Grade, Grounding, 2 Pole, 3 Wire, 1S Amperes, 12S Volts, S0/60 Hertz (Female)

OTHER PUBLICATIONS:

FM Orders

Order 1320.33 Equipment Modification and Facility Instruction Direction

Order 1810.6 Policy for Use of Non-developmental Items (NDI) in FAA Acquisitions

Order 3910.3 Radiation Health Hazards and Protection

Order 050.2 Electrical Power Policy Implementation u National Airspace System Facilities

Order 6980.24 Battery Theory and Selection Guidelines

Code of Federal Regulations

Title 10, Nuclear Regulatory Commission Regulations, Parts 0-199

Title 21, Food and Drug Administration Regulations, Parts 1-1299

Tide 29, Occupational Safety and HealthAdministration Regulations, Parts 190>1999

Title 47, Frequency Allocations and Radio Trety Matters: General Rules and Part 2 Regulations

Title 47, Radio Frequency Devices, Part 15

Title 47, Connection of Terminal Equipment tO the Telephone Network, Part 68

Manual

NTIA Manual National Telecommunications and Information Administration Manual of

Regulations and Procedures for Radio Frequency Management

Handbooks

MIL-HDBK-5 Metallic Materials and E:lements for Aerospace Vehicle Structures

MIL-HDBK-217 Reliability Prediction of Electronic Equipment

MIL-HDBK-251 Reliability/Design Thermal Applications

M1L-HDBK-472 Maintainability Predictions

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specified procurement functions should be obtained from the government prograrn office or as directed by the contracting officer).

APPENDIX III

30.0 NON-GOVERNMENT DOCUMENTS

The following documents of the issue in effect on the date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this specification, the contents of this specification shall be considered a superseding requirement.

STANDARDS:

AGMA Various Standards

(American Gear Manufacturers Association, l500 King Street, Suite 210, Alexandria VA 22314)

ANSI

ANSI J/STD 001	Requirements for Soldered Electrical and Electronic Assemblies
ANSI N2.1	Radiation Symbol
ANSI C39.1	Electrical Analog Indicating Instruments, Requirements for
ANSI Z535.1	Safety Color Code
IEEE std 200	IEEE Standard Reference Designations for Electrical and Electronics Parts And Equipment
EIA-310-D	Cabinets, Racks, Panels, and Associated Equipment
IEEE std 100	The New IEEE Standard Dictionary of Electrical and Electronics Terms
IEEE std 315	Graphic Symbols for Electrical and Electronics Diagrams
ANS/EIA-599	National Electronic Process Certification Standard

(American National Standards Institute, 11 West 42nd Street. New York, NY (10036.)

ASTM

ASTM G21	Determining Resistance of Synthetic Polymeric Materials to Fungi, Practice for

ASTM D 495 High-Voltage, Low-Current, Dry Arc Resistance of Solid Electrical Insulation Standard Test Method for

ASTM B 633 Electrodeposited Coatings of Zinc on Iron and Steel, Standard Specification for

ANSI/ASTM D 568 Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Flexible Plastics in a Vertical Position

ASTM D 635 Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position

ASTM D 1000 Standard Test Method for Pressure-Sensitive Adhesive Coated Tapes Used For Electrical Insulation, Methods of Testing

ASTM D 1868 Standard Test Method for Detection and Measurement of Partial Discharge (Corona) Pulses in Evaluation of Insulation Systems

ASTM D 3951 Standard Practices for Commercial Packaging

(American Society for Testing Materials. 1916 Race Street, Philadelphia PA 19103.)

AWS

ANSI/AWS A2.4 Standard Symbols for Welding, Brazing and Nondestructive Examination

AWS A3.0 Welding Terms and Definitions Including Terms for Brazing, Soldering, Thermal Spraying and Thermal Cutting

(American Welding Society lnc., 550 N.W. LeJeune Road. PO Box 351040, Miami, Florida (33135.)

ECSA

TR No. 5 Technical Report on Carrier to Customer installation Interface Connector Wiring Configuration Catalog

(Exchange Carriers Standards Association, Suite 500, 1200 G Street, N.W., Washington, DC 20005)

EIA

EIA-JESD-23 Test Methods and Character Designators for Liquid Crystal Devices

(Electronics Industry Association, 2001 Pennsylvania Avenue, N.W., Washington, D.C. 20006)

IPC

ANSI/IPC-SM-780 Component Packaging and Interconnecting with Emphasis on Surface Mounting

ANSI/IPC-L-108 Specification for Thin Metal Clad Base Materials for Multilayer Printed Boards

ANSI/IPC-L-109 Specification for Resin Preimpregnated Fabric (Prepreg) for Multilayer Printed Boards

ANSI/IPC-L-ll5 Specification for Rigid Metal (Clad Base Materials for Printed Boards)

ANSI/IPC-RF-245 Performance Specification for Rigid-Flex Printed Boards

ANSI/IPC-FC-250 Specification for Single- and Double-Sided Flexible Printed Wiring

IPC-D-275 Design Standard for Rigid Printed Boards and Rigid Printed Board Assemblies

ANSI/IPC-RB-276 Qualification and Performance Specification for Rigid Printed Boards

ANSI/IPC-A-600 Acceptability of Printed Boards

IPC-CM-770 Guidelines for Printed Board Component Mounting

ANSI/IPC-A-610 Acceptability of Printed Board Assemblies

(Institute for Interconnecting and Packaging Ellectronic Circuits, 7380 N. Lincoln Ave., Lincolnwood, IL 60646)

NFPA	NFPA 70 National Electrical Code

(National Fire Protection Association, One Batterymarch Park, PO Box 9101, Quincy, MA 02269-9101)

UL

UL 94	Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
UL 1418	Cathode-Ray Tubes
UL 1642	Lithium Batteries
UL l950	Safety of Information Technology Equipment Including Office Electronic Equipment

(Underwriters Laboratories, Inc., Publications Stock. 333 Pfingsten Road, Northbrook, IL 60062-2096)

(Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)